Chapter 2 — Public Participation, Issue Identification, and Alternatives

This chapter covers five primary topics. First, it describes the process used to obtain the public's concerns and identifies the issues raised by the public. Then, it describes the process used to develop the alternatives considered in this analysis. Third, it describes the project alternatives analyzed in detail. The specific features of these alternatives are fully described. Fourth, it identifies each alternative dropped from detailed consideration and briefly describes the reasoning for the exclusion. Finally, it summarily presents, in comparative form, the components and environmental effects of the alternatives analyzed in detail and identifies the agencies' preferred alternative.

Public Participation

The BLM and FS consider public participation a crucial component in defining the scope of the environmental analysis presented in this EIS. Consequently, the agencies worked to ensure the public was informed about the Companies' proposal and the opportunities available for participating in the environmental process.

The agencies first informed the public of the BLM and FS' intent to conduct an environmental impact analysis of oil and gas development within the PRB during May and June 2000. In May, the agencies prepared and mailed almost 900 copies of a Scoping Letter, which solicited comments from its readers to assist the BLM and FS in identifying the specific issues and concerns the agencies should address in the analysis and document in the EIS.

On 21 June 2000, formal scoping for the analysis began with publication in the Federal Register of a Notice of Intent (NOI) to prepare an EIS. The BLM published additional notices in the Federal Register to correct mistakes in the first NOI and to invite the public's participation in the analysis and potential amendments to the Buffalo and Platte River Resource Management Plans.

The BLM also sent a news release to more than 60 media outlets (e.g., newspapers, radio stations, and television stations) in Wyoming and Montana. This news release announced the agencies' intention to prepare an EIS and identified the public meetings. Additionally, several newspapers prepared stories on the project.

In addition to the publications and mailings, the agencies held four public meetings to discuss the proposal and receive comments from the public. The first meeting was held in Sheridan, Wyoming on 6 June 2000. The second and third meetings were held in Buffalo, Wyoming and Gillette, Wyoming on 7 and 8 June 2000, respectively. The final meeting was held in Douglas, Wyoming on 12 June

2000. At all meetings, the proposal was described and attendees were provided the opportunity to ask questions and submit comments.

Finally, the BLM and FS have been keeping the public informed of the analysis' status through a periodic newsletter and project-specific web site (www.prb-eis.org). The BLM also placed project information on its Wyoming web site.

Issue Identification and Issue Statements

The BLM and FS reviewed and analyzed the comments they received during the scoping process. Public response to the notices and meetings included 74 letters, comment forms, and e-mails. Also, a total of 106 people attended one or more of the four public meetings.

The agencies' process for identifying issues involved three overall steps. First, specific comments were arranged into groups of common concerns. Next, a primary issue statement was prepared for each group of comments. Finally, the issue statements were evaluated for applicability to this NEPA analysis.

The analysis of comments initially identified 27 issues. Eighteen of these 27 issues were identified as key or significant issues (see November 2000 Scoping Summary to review nonsignificant issues). These issues were used to define the scope of this NEPA analysis. These key issues were used to analyze environmental effects, prescribe mitigation measures, or both. Issues are "significant or key" due to the extent of their geographic distribution, the duration of their effects, or the intensity of interest or resource conflict. The determination of an issue's significance is different than and separate from any determination of the significance of an environmental consequence. The other nine issues were not identified as key because they involved standard parts of a NEPA analysis (e.g., the analysis must consider an adequate range of alternatives) or the agencies determined they were beyond the scope of this NEPA analysis. The 18 key issues that comprised the overall scope of the NEPA analysis are:

Issue 1: The effects of the additional development of oil and gas resources on aquifers present in and down gradient of the project area.

Respondents expressed concerns about the effects on local aquifers of depressurizing coal beds through the pumping of water. Landowners identified concerns about the pumping causing them to lose the use of their existing water wells, which are sources of water for the consumption of both humans and livestock. Concerns include direct losses (loss of water wells drilled into coal aquifers) and indirect losses (loss of water wells drilled into aquifers located above, but connected with, the coal beds). Some respondents also are concerned that pumping water from the coal seams could increase the potential for subsidence, which could adversely affect aquifers. Because the availability of uninterruptible supplies of ground water are important to the economic well-being of landowners in the project area, respondents requested ground water modeling specifically to address the rates of pumping, horizontal and vertical movement of ground water, recharge of aquifers, interdependence of aquifers, permeability of overburden and layers between the coal seams, and the cumulative effects of depletions due to oil and gas and depletions resulting from coal mining.

Issue 2: The effects of the additional development of oil and gas resources on the quantity and distribution of surface water in and downstream of the project area.

Many respondents expressed concerns about the volumes of surface water the Companies would discharge from CBM wells into drainages across the project area. Considering the potential number of wells and the rates projected for the discharge of produced water from each well, discharges could be too great for some channels to handle, which would cause sheet flows across lands instead of flows constrained to the channels of streams. These volumes could overwhelm the Companies and landowners' abilities to contain or control the flow of water across properties, which would affect the landowners' uses of the properties. This problem already is evident on some properties where channels have been replaced with spreader dikes. The additional volumes of water may also affect the operation of reservoirs in and downstream of the project area. Consequently, respondents thought the analysis should determine and disclose the volumes of produced water expected by watershed (a single "type curve" for production throughout the project area should not be used). Additionally, they suggested the development of detailed watershed plans specifically to address these concerns.

Issue 3: The effects of the additional development of oil and gas resources on the quality of surface water in and downstream of the project area and the potential to adversely affect current uses of those surface waters.

Many respondents expressed concerns about the quality of produced water the Companies would discharge into surface drainages and how that produced water would affect the existing quality of surface water and other resources that depend on that water. They cited incidental observations suggesting produced water may impair surface waters by introducing metals (e.g., iron, manganese, and barium), increasing the SAR, and increasing sedimentation; kill vegetation (e.g., sagebrush and grass) with which it comes into contact; adversely affect lands and crops irrigated with it; adversely affect sources of municipal water; and adversely affect wildlife and livestock. Produced water also may alter the temperatures of streams receiving the discharges. Concerns were greatest for rivers classified as impaired (i.e., the Tongue, Powder, and Belle Fourche rivers in Montana and South Dakota). Finally, respondents identified a need for long-term monitoring of the quality of produced water discharged to surface waters.

Issue 4: The effects of the additional development of oil and gas resources on the project area's geology, geologic hazards, and the extraction of other mineral resources present in the project area.

Respondents expressed concerns about the effects the additional development of oil and gas resources may have on the extraction of other minerals in the project area, particularly coal. Some questioned how the extent of development considered in the alternatives could adversely affect the mining companies' ability to mine coal. Also, they questioned whether the extraction of ground water from the coal seams could increase the potential for subsidence such that it could adversely affect the ability to mine coal or other minerals or whether any reinjection of produced water could increase the potential for earthquakes. Areas prone to landslides need to be considered. Respondents thought the inclusion of a detailed map of the project area's geology would help readers comprehend the situation more completely.

Issue 5: The effects of the additional development of oil and gas resources on soils in and downstream of the project area.

Respondents expressed concerns about the project increasing the loss of topsoil through erosion (via both water and wind), particularly where the Companies would discharge the produced water. Other concerns include the project's potential for increasing the compaction of soils and adversely affecting local soils' structure and fertility.

Issue 6: The effects of the additional development of oil and gas resources on air quality and visibility.

Respondents expressed concerns about the effects of the additional oil and gas development on the project area's visibility and quality of air. Construction of new roads and facilities and increases in traffic would result in increases in particulates. Construction of new gas-fired compressors and increases in the volumes of traffic would result in additional gaseous emissions. These increases could impair the quality of air and visibility, which also may affect the health of humans, wildlife, and livestock (e.g., dust pneumonia). Concern also was expressed about long-term venting of methane and its potential effects to air quality. Respondents were concerned about the alternatives' effects on visibility at Class I areas within the project area's effective airshed.

Issue 7: The effects of the additional development of oil and gas resources on vegetation in and downstream of the project area, including wetlands and riparian areas.

Respondents expressed concerns that the additional development of oil and gas resources would adversely affect the project area's vegetation generally and wetlands and riparian areas specifically. Construction of facilities would directly disturb vegetation over both the short term and long term. Changes in the volumes and rates of surface water flows could alter the distribution of vegetative cover types. Wetlands and riparian areas would be most susceptible to changes in the quantity and quality of surface waters. Areas with intermittent flows may experience perennial flows as development expands. Also, disturbances in the project area could increase the potential for the spread of noxious plants at the expense of displacing native vegetation.

Issue 8: The effects of the additional development of oil and gas resources on species of wildlife and their habitats (particularly key species and habitats).

Respondents expressed concerns that the additional oil and gas development would directly, indirectly, and cumulatively affect species of wildlife and their habitats. Species or groups of species for which they identified specific concerns include raptors, sage grouse, sharp-tailed grouse, deer, elk, antelope, and waterbirds. The effects that concerned most respondents include the direct loss of habitats (particularly crucial winter ranges for large deer, elk, and antelope), disturbance of animals by humans (including additional noise), fragmentation of habitats (primarily through the construction of roads, well pads, and fences), introduction of new perches for raptors, increases in hunting pressure, increases in harassment, and project-induced increases in mortality (e.g., poaching, trapping, poisoning, and roadkills).

Issue 9: The effects of the additional development of oil and gas resources on fisheries and aquatic habitats.

Respondents expressed concerns about the potential direct, indirect, and cumulative effects of the additional oil and gas development on fisheries and the aquatic habitats upon which they depend. The discharge of produced waters could affect fisheries and aquatic habitats by altering the quantity, quality, and temperature of waters in steams and rivers. These concerns were greatest for streams and rivers containing special-concern species of fish and rivers classified as impaired (i.e., the Tongue, Powder, and Belle Fourche rivers in Montana and South Dakota).

Issue 10: The effects of the additional development of oil and gas resources on the project area's ecological integrity and biological diversity.

Respondents expressed concerns that additional oil and gas development could adversely affect the natural ecological integrity in and downstream of the project area. The additional oil and gas development could alter the project area's biological diversity by changing species composition, abundance, and the distribution of plants and animals. Because different species of wildlife require different levels of habitat diversity, these changes are important to a number of species. Areas specifically identified for being of importance to the conservation of biological diversity in the region include the Little Powder River (river banks and adjacent upland sites), Powder River, and Upper Antelope Creek (including the rolling uplands).

Issue 11: The effects of the additional development of oil and gas resources on special-concern species, particularly threatened, endangered, candidate, or sensitive species of plants and animals.

Respondents expressed concerns that the additional oil and gas development could adversely affect special-concern species, including species of plants and animals listed as threatened or endangered, proposed for or identified as candidates for listing as threatened or endangered, or identified as sensitive by the BLM or Regional Forester. Species of particular concern to respondents include the black-footed ferret, bald eagle, mountain plover, Ute ladies'-tresses orchid, black-tailed prairie dog, swift fox, sturgeon chub, pallid sturgeon, shovelnose sturgeon, and western silvery minnow. Some respondents noted the need for the analysis to comply with Section 7 of the Endangered Species Act (ESA).

Issue 12: The effects of the additional development of oil and gas resources on rangeland resources and grazing operations.

Respondents expressed concerns about the effects of the additional development of oil and gas resources on rangeland resources and grazing operations. The potential loss of water wells for livestock, changes in grazing patterns due to long-term flooding of hayfields and winter ranges, and the consumption of lower-quality produced water by livestock, are the primary concerns. Additional concerns included fencing, the harassment of livestock, and the potential for project-induced health problems (e.g., dust pneumonia and undernourishment).

Issue 13: The effects of the additional development of oil and gas resources on cultural resources, paleontological resources, and Native Americans.

Respondents expressed concerns about the potential for the additional development of oil and gas resources to adversely affect cultural resources, paleontological resources, and Native Americans. In addition to the direct and indirect disturbances associated with the construction of facilities, the discharge of produced waters could increase streamflows sufficiently to disturb cultural resources present in steambeds. Also, the Northern Cheyenne Indian Reservation, which is in the Upper Tongue River watershed immediately downstream of the project area, may experience adverse effects from the project.

Issue 14: The effects of the additional development of oil and gas resources on recreational opportunities and the recreational experience.

Respondents expressed concerns about the degree to which the additional development of oil and gas resources would alter the existing recreational setting and experience. Activities would add new sources of noise that could diminish the recreational experience. New roads would provide access for vehicles and promote an increase in human activity. Also, implementation of the additional development could adversely affect the wildlife-related recreation (e.g., viewing wildlife, hunting wildlife, and fishing). However, the development of certain facilities, such as reservoirs for impounding produced water, could enhance some wildlife-related recreational opportunities by providing areas for viewing wildlife, hunting waterfowl, or public fishing.

Issue 15: The effects of the additional development of oil and gas resources on the project area's aesthetics.

Respondents expressed concerns about the effects of the additional development of oil and gas resources on the project area's aesthetics. Levels of noise would increase with the addition of compressors, pumps, and traffic. Human activity would become much more visible with the addition of many miles of roads, pipelines, power lines, and fences. These additional features would affect the area's visual quality and cause conflicts with the BLM and FS' visual management systems, which could affect the agencies' management of federal lands in the project area.

Issue 16: The effects of the additional development of oil and gas resources on the local economy.

Respondents expressed concerns about the effects of the additional development of oil and gas resources on the local economy. Some felt the additional development would cause more damage to the local economy over the long term than any monetary gain obtained from the leases, royalties, taxes, and jobs. Of particular concern is the discharging of large amounts of ground water onto the ground surface because ground water is considered vital to the economic well being of the rural communities and it should be attributed some economic value in the analysis. Also of concern, are the effects on the availability of affordable housing, an adequate community infrastructure to support an influx of people (e.g., law enforcement, medical facilities, schools, and transportation network), and property values. Some respondents identified concerns about the potential for the project to affect employment and opportunities for employment in Montana by attracting workers away from agriculture and other traditionally lower paying occupations.

Issue 17: The effects of the additional development of oil and gas resources on human health and safety.

Several respondents expressed concerns about potential dangers or threats to human health and safety with the additional development of oil and gas resources. These concerns included the potentials for and the effects of methane migrating into residences and water wells and seeping out at outcrops (killing vegetation and wildlife), spontaneous combustion of depressurized coals resulting in uncontrollable underground fires, contamination of drinking water aquifers by the chemicals used in hydraulic fracturing, ruptures of pipelines, spills, illegal dumping, and the application of treatments to roads (e.g., magnesium chloride).

Issue 18: The analysis needs to include an analysis of environmental justice.

Concerns were expressed about the potential of the additional development of oil and gas resources to affect Native American Tribes in Montana. Of particular concern are the Northern Cheyenne and Crow. At a minimum, an analysis of environmental justice should be completed for these Tribes.

Process Used to Develop Alternatives

The process of developing alternatives to the Proposed Action involved four steps. First, the agencies conducted project scoping to identify the key issues of concern. This scoping involved both internal agency and public concerns. It also considered environmental and project-design elements.

The second step consisted of formulating alternatives to the proposal. Each alternative had to meet the purpose of and need for the project. Typically, driving issues are identified that help the agencies define what changes need to be made to avoid, eliminate, reduce, minimize, or mitigate effects that would result from implementing the Proposed Action. The agencies identified three issues (Numbers 2, 3, and 6) as the potential driving issues for this EIS.

The third step involved screening the potential alternatives for reasonableness. The NEPA process requires that alternatives evaluated in detail be reasonable. The regulations for implementing NEPA provide a discussion of the need for reasonable alternatives in the NEPA process (40 CFR 1500.1(e) and 1502.14). Also, CEQ's 40 Most Asked Questions about NEPA (Question 2a) state, in part, that "reasonable alternatives include those that are practical or feasible from the technical and economic standpoint and using common sense" (CEQ 1981).

Based on this direction, the agencies focused their screening of alternatives on technical, environmental, and economic feasibility. Technical considerations included the feasibility of constructing and operating the facilities. Environmental considerations included the potential for significant effects and the feasibility of successfully mitigating the effects of the alternative. Economic considerations included potential costs and benefits of implementing the alternative.

Finally, unreasonable alternatives were dropped from detailed consideration. If an alternative did not pass the technical, environmental, and economic screening for feasibility, it was not considered any further in the analysis.

Alternatives Considered in the NEPA Analysis

The process described above resulted in the development of several alternatives that specifically responded to one or more key issues. Although a variety of alternatives was developed, not all of the alternatives were analyzed in detail. Some were determined to be unreasonable during the feasibility screening. Others were eliminated after initial analysis indicated they were not reasonable or conditions changed, such as the signing of the Interim Memorandum of Cooperation (MOC) by Montana and Wyoming (Appendix B) to document their commitments and intent to protect and maintain water quality conditions in the PRB within Montana.

The alternatives developed for this NEPA analysis are described in two overall sections. The alternatives analyzed in detail are described first. A section on Alternatives Considered but Eliminated follows the alternatives analyzed in detail (beginning on page 2–62).

Alternatives Analyzed in Detail

Three alternatives were analyzed in detail. They include the Proposed Action (Alternative 1) and No Action Alternative (Alternative 3). Alternatives 2A and 2B are the Proposed Action with Reduced Emission Levels and Expanded Disposed Water Handling Scenarios. The Proposed Action is described first. The descriptions of alternatives 2 and 3 follow and focus on how they differ from the Proposed Action.

In addition to the details presented below, the action alternatives (Alternatives 1, 2A, and 2B) include the Standard Conditions of Approval (COAs) for APDs that the BLM has been requiring for oil and gas wells drilled into federal minerals in the Project Area. These COAs are included as Appendix C.

Alternative 1 — Proposed Action

The Proposed Action is to continue development of CBM and conventional oil/gas resources within the Project Area. It is projected that an additional 39,367 CBM wells and 3,200 conventional oil/gas wells would be developed over the next ten years.

This alternative is a combination of the Companies' proposal and the BLM's RFD Scenario. The BLM used the RFD Scenario's moderate level of development and the Companies' proposal to establish the overall level of development of CBM resources likely for this alternative. The Companies' proposal provided the basis for how the Companies would implement the CBM portion of the alternative (e.g., drilling, completion, operation, and reclamation). The BLM used the RFD Scenario to establish the overall level of additional development of non-CBM resources within the PRB.

The result of combining the Companies' proposal and the RFD Scenario is a Proposed Action that consists of two primary components. The first is the CBM wells and their ancillary facilities. The second component is the non-CBM wells and their ancillary facilities. Because these two components use different technologies and techniques and involve different levels of disturbance, they are discussed separately.

Coal Bed Methane Development

Under this alternative, the Companies' would drill, complete, and operate 39,367 new CBM wells within the Project Area over a 10-year period (Table 2–1). Including the 12,077 CBM wells already drilled or permitted for drilling in the Project Area, the Companies would drill, complete, and operate 51,444 CBM wells by the end of 2011 (Figure 2–1 and Table 2–2).

The Companies also would construct the ancillary facilities needed to support these wells. The ancillary facilities include access roads; pipelines for gathering gas and produced water; electrical utilities; facilities for measuring and compressing gas; facilities for treating, discharging, disposing of, containing, or injecting produced water; and pipelines for delivering gas to high-pressure transmission pipelines. These transmission pipelines would deliver the gas to market.

The overall life of the Proposed Action, including drilling, production, and reclamation, is expected to be about 20 years. Construction of the 39,367 new wells would begin during 2002. The Companies would drill these wells over a 10-year period (Table 2–1). The productive life of each well is expected to be about 7 years. Accordingly, production from at least some of the 39,367 new wells is expected to last until 2018. Final reclamation of these wells would occur during the two to three years following the end of production. Thus, the Proposed Action would be completed around 2021.

In parts of the Project Area, several coal beds occur together. In these areas, the standard practice presently is to drill a separate well to develop each coal bed. Where possible, the Companies would collocate these wells on the same well pad. Based on this practice of collocation and knowledge of where multiple gas-productive coal beds exist, the BLM and Companies project the 39,367 new wells would be drilled from about 26,000 well pads (Table 2–3). The total number of wells and well pads is based on an 80-acre well spacing pattern overall (eight pads per square mile). Including the pads constructed for wells drilled before 2002, the 51,444 CBM wells would be distributed across almost 35,600 well pads (Table 2–4 and Figure 2–1). The number of wells on a pad would range from one to three.

Under the Proposed Action, the Companies would drill, operate, and maintain wells and construct ancillary facilities in 10 of the 18 sub-watersheds that comprise the Project Area (Table 2–5). However, most of the new wells (63 percent) and facilities would be constructed in two sub-watersheds: the Upper Powder River and Upper Belle Fourche River sub-watersheds. Other sub-watersheds with relatively high numbers of wells and facilities include Clear Creek, Crazy Woman Creek, Upper Tongue River, and Little Powder River.

Overall, implementation of the CBM portion of the Proposed Action could disturb as many as 211,992 surface acres, most of which would be associated with the construction of pipelines, roads, and water handling facilities (Table 2–6).

Compressor stations would account for the smallest amount of the overall surface disturbance. Short-term disturbance would encompass about 3 percent of the Project Area.

Following reclamation of pipelines partial reclamation of other facilities, such as well pads, the Proposed Action's long-term disturbance from CBM development would encompass about 108,800 acres (Table 2–7). The long-term disturbance is a 45 percent reduction from the total short-term disturbance. The roads and water handling facilities would comprise most of the long-term disturbance.

The following sections describe the Proposed Action in detail. Implementation would occur in three primary phases: drilling of wells and construction of production facilities, production and maintenance, and decommissioning and reclamation. Consequently, the detailed description of the Proposed Action is organized by these three primary phases.

Drilling of Wells and Construction of Production Facilities

This section describes the overall procedures, techniques, and resources the Companies would use to construct roads, well pads, and ancillary production facilities and to drill, case, and complete the CBM wells.

Well Access Roads

Most roads to well pads (resource roads) would be developed in two steps. Initially, each road would be roughed in as a two-track road. Generally, the BLM requires improved graded and graveled roads to non-CBM operations. However, because the need to travel to the CBM wells is normally very limited, the BLM has waived the blanket requirements for road improvements to minimize surface disturbance. Any need for surfacing or other upgrading would be determined in consultation with the BLM or other landowner based on site-specific conditions. In some cases, roads may require upgrading before drilling the wells. However, if the well is not completed successfully and is plugged, the road would be reclaimed.

Unless work is needed to alleviate concerns about safety, environmental issues, or access difficulties, the Companies would maintain roads used to access well pads in a two-track status. Areas where work may be needed include stream drainage crossings, low water crossings, and rough topography. Gravel may be applied to problem areas. Also, travel on two-track roads would be rescheduled or postponed during the infrequent periods of wet weather when vehicular traffic could cause rutting.

The BLM's experience in more rugged terrain, such as within the Powder River drainage, suggests construction of a more substantial access road to the well pad using cut and fill construction techniques may be necessary about 20 percent of the time within the Project Area. Surface disturbance associated with crowning and ditching (normally required by BLM's general policy on design and construction of oil and gas well access roads) would occur only as required for access roads traversing steeper terrain or rough, broken topography, or in other exceptional site-specific circumstances.

Figure 2–1 Distribution of Existing and Proposed Wells Pads

Table 2–1 Distribution of New Producing CBM Wells by Sub-watershed — Alternative 1

	Year										
Sub-watershed	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total
Little Bighorn River	0	0	0	0	0	0	0	0	0	0	0
Upper Tongue River	101	277	277	277	277	277	277	277	277	272	2,589
Middle Fork Powder River	0	0	0	0	0	0	0	0	0	0	0
North Fork Powder River	0	0	0	0	0	0	0	0	0	0	0
Upper Powder River	2,785	2,640	2,640	2,514	2,499	2,499	2,012	488	455	435	18,967
South Fork Powder River	0	0	0	0	0	0	0	0	0	0	0
Salt Creek	10	6	7	6	8	0	0	0	0	0	37
Crazy Woman Creek	304	351	351	351	346	346	316	191	186	178	2,920
Clear Creek	263	400	400	400	405	405	405	361	359	355	3,753
Middle Powder River	45	102	102	102	102	102	102	102	102	97	958
Little Powder River	214	229	229	229	235	235	235	149	144	136	2,035
Little Missouri River	0	0	0	0	0	0	0	0	0	0	0
Antelope Creek	250	216	216	208	210	210	177	54	52	51	1,644
Dry Fork Cheyenne River	0	0	0	0	0	0	0	0	0	0	0
Upper Cheyenne River	80	65	65	65	65	65	62	30	21	15	533
Lightning Creek	0	0	0	0	0	0	0	0	0	0	0
Upper Belle Fourche River	908	751	751	738	760	760	710	201	178	174	5,931
Middle North Platte River	0	0	0	0	0	0	0	0	0	0	0
Total	4,960	5,037	5,038	4,890	4,907	4,899	4,296	1,853	1,774	1,713	39,367

Source: BLM 2001e

Table 2–2 Distribution of All CBM Wells by Sub-watershed — Alternative 1

Sub-watershed	Pre-2002[1]	Year										Total
		2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	
Little Bighorn River	0	0	0	0	0	0	0	0	0	0	0	0
Upper Tongue River	815	101	277	277	277	277	277	277	277	277	272	3,404
Middle Fork Powder River	0	0	0	0	0	0	0	0	0	0	0	0
North Fork Powder River	0	0	0	0	0	0	0	0	0	0	0	0
Upper Powder River	2,808	2,785	2,640	2,640	2,514	2,499	2,499	2,012	488	455	435	21,775
South Fork Powder River	0	0	0	0	0	0	0	0	0	0	0	0
Salt Creek	0	10	6	7	6	8	0	0	0	0	0	37
Crazy Woman Creek	150	304	351	351	351	346	346	316	191	186	178	3,070
Clear Creek	389	263	400	400	400	405	405	405	361	359	355	4,142
Middle Powder River	727	45	102	102	102	102	102	102	102	102	97	1,685
Little Powder River	1,813	214	229	229	229	235	235	235	149	144	136	3,848
Little Missouri River	0	0	0	0	0	0	0	0	0	0	0	0
Antelope Creek	253	250	216	216	208	210	210	177	54	52	51	1,897
Dry Fork Cheyenne River	0	0	0	0	0	0	0	0	0	0	0	0
Upper Cheyenne River	454	80	65	65	65	65	65	62	30	21	15	987
Lightning Creek	0	0	0	0	0	0	0	0	0	0	0	0
Upper Belle Fourche River	4,662	908	751	751	738	760	760	710	201	178	174	10,593
Middle North Platte River	6	0	0	0	0	0	0	0	0	0	0	6
Total	12,077	4,960	5,037	5,038	4,890	4,907	4,899	4,296	1,853	1,774	1,713	51,444

Note:

1. The Pre-2002 wells include wells already drilled (some of which are producing) and those projected for completion by 2002 (but not necessarily producing).

Source: BLM 2001e

Table 2–3 Distribution of New Well Pads by Sub-watershed — Alternative 1

	Year										
Sub-watershed	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total
Little Bighorn River	0	0	0	0	0	0	0	0	0	0	0
Upper Tongue River	41	111	138	109	93	148	140	132	103	124	1,139
Middle Fork Powder River	0	0	0	0	0	0	0	0	0	0	0
North Fork Powder River	0	0	0	0	0	0	0	0	0	0	0
Upper Powder River	1,744	1,806	1,602	1,582	1,613	1,574	1,104	288	340	189	11,842
South Fork Powder River	0	0	0	0	0	0	0	0	0	0	0
Salt Creek	10	6	7	6	8	0	0	0	0	0	37
Crazy Woman Creek	304	319	225	235	217	194	153	103	88	60	1,898
Clear Creek	212	296	276	252	308	255	255	269	233	228	2,584
Middle Powder River	21	50	48	47	48	50	50	51	51	49	465
Little Powder River	137	162	135	142	154	118	149	74	108	86	1,265
Little Missouri River	0	0	0	0	0	0	0	0	0	0	0
Antelope Creek	232	195	192	184	202	169	162	46	44	25	1,451
Dry Fork Cheyenne River	0	0	0	0	0	0	0	0	0	0	0
Upper Cheyenne River	80	65	65	65	65	65	62	30	21	15	533
Lightning Creek	0	0	0	0	0	0	0	0	0	0	0
Upper Belle Fourche River	809	627	629	583	586	578	574	114	153	130	4,783
Middle North Platte River	0	0	0	0	0	0	0	0	0	0	0
Total	3,590	3,637	3,317	3,205	3,294	3,151	2,649	1,107	1,141	906	25,997

Source: BLM 2001e

Table 2–4 Distribution of All CBM Well Pads by Sub-watershed — Alternative 1

Sub-watershed	Pre-2002	Year										Total
		2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	
Little Bighorn River	0	0	0	0	0	0	0	0	0	0	0	0
Upper Tongue River	396	41	111	138	109	93	148	140	132	103	124	1,535
Middle Fork Powder River	0	0	0	0	0	0	0	0	0	0	0	0
North Fork Powder River	0	0	0	0	0	0	0	0	0	0	0	0
Upper Powder River	2,253	1,744	1,806	1,602	1,582	1,613	1,574	1,104	288	340	189	14,095
South Fork Powder River	0	0	0	0	0	0	0	0	0	0	0	0
Salt Creek	0	10	6	7	6	8	0	0	0	0	0	37
Crazy Woman Creek	63	304	319	225	235	217	194	153	103	88	60	1,961
Clear Creek	229	212	296	276	252	308	255	255	269	233	228	2,813
Middle Powder River	434	21	50	48	47	48	50	50	51	51	49	899
Little Powder River	1,301	137	162	135	142	154	118	149	74	108	86	2,566
Little Missouri River	0	0	0	0	0	0	0	0	0	0	0	0
Antelope Creek	251	232	195	192	184	202	169	162	46	44	25	1,702
Dry Fork Cheyenne River	0	0	0	0	0	0	0	0	0	0	0	0
Upper Cheyenne River	389	80	65	65	65	65	65	62	30	21	15	922
Lightning Creek	0	0	0	0	0	0	0	0	0	0	0	0
Upper Belle Fourche River	4,270	809	627	629	583	586	578	574	114	153	130	9,053
Middle North Platte River	6	0	0	0	0	0	0	0	0	0	0	6
Total	9,592	3,590	3,637	3,317	3,205	3,294	3,151	2,649	1,107	1,141	906	35,589

Source: BLM 2001e

Table 2–5 Summary of New CBM Facilities Comprising Alternative 1

		Roads		Poly Pipeline		Steel Pipeline	Electrical Line	Recip Compressors[1]		Booster Compressors[2]	
Sub-watershed	Well Pads	Improved (miles)	Two-track (miles)	2–3-inch (miles)	12-inch (miles)	12-inch (miles)	Overhead (miles)	(units)	(horsepower)	(units)	(horsepower)
Little Bighorn River	0	0	0	0	0	0	0	0	0	0	0
Upper Tongue River	1,139	307	430	571	215	70	215	9	14,850	31	10,850
Middle Fork Powder River	0	0	0	0	0	0	0	0	0	0	0
North Fork Powder River	0	0	0	0	0	0	0	0	0	0	0
Upper Powder River	11,842	2,151	3,002	3,996	1,501	521	1,501	192	316,800	691	241,850
South Fork Powder River	0	0	0	0	0	0	0	0	0	0	0
Salt Creek	37	43	72	96	36	7	36	1	1,650	4	1,400
Crazy Woman Creek	1,898	468	680	905	340	108	340	21	34,650	72	25,200
Clear Creek	2,584	473	748	995	374	76	374	14	23,100	49	17,150
Middle Powder River	465	141	155	207	78	39	78	3	4,950	9	3,150
Little Powder River	1,265	496	872	1,161	436	45	436	9	14,850	30	10,500
Little Missouri River	0	0	0	0	0	0	0	0	0	0	0
Antelope Creek	1,451	1,567	3,038	4,041	1,519	35	1,519	11	18,150	40	14,000
Dry Fork Cheyenne River	0	0	0	0	0	0	0	0	0	0	0
Upper Cheyenne River	533	127	137	182	69	37	69	5	8,250	16	5,600
Lightning Creek	0	0	0	0	0	0	0	0	0	0	0
Upper Belle Fourche River	4,783	884	1,483	1,973	743	98	743	33	54,450	118	41,300
Middle North Platte River	0	0	0	0	0	0	0	0	0	0	0
Total	25,997	6,657	10,619	14,127	5,311	1,036	5,311	298	491,700	1,060	371,000

Notes:

1. Reciprocating (Recip.) compressors increase the compression of natural gas for delivery to high-compression transmission pipelines. Each station would consist of 1 to 6 recip compressors, depending upon the volume of gas being delivered to the station.
2. Booster compressors enhance the flow of gas from the wells to the recip compressors. Each station would consist of 1 to 6 booster compressors, depending upon the volume of gas being delivered to the station.

Source: BLM 2001e

Table 2–6 Summary of Estimated Short-term CBM Disturbance Associated with Alternative 1

			Roads		Poly Pipeline		Water Handling	Compressor Discharge Pipelines		Power Line	Compressor Stations		
	Well Pads	CMFs	Improved	Two-track	2–3-inch	12-inch	Facilities[1]	Recip.[2]	Booster[3]	Overhead	Recip.	Booster	Total
Sub-watershed	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)
Little Bighorn River	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Tongue River	632	59	708	2,083	2,077	782	3,120	248	606	782	25	10	11,132
Middle Fork Powder River	0	0	0	0	0	0	0	0	0	0	0	0	0
North Fork Powder River	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Powder River	4,978	435	4,973	14,556	14,529	5,459	12,423	1,788	4,527	5,459	415	166	69,708
South Fork Powder River	0	0	0	0	0	0	0	0	0	0	0	0	0
Salt Creek	11	1	78	351	350	132	34	24	61	132	5	2	1,181
Crazy Woman Creek	774	67	1,030	3,299	3,289	1,235	2,102	291	1,014	1,235	50	20	14,406
Clear Creek	1,009	86	936	3,628	3,620	1,360	4,391	320	605	1,360	35	14	17,364
Middle Powder River	238	22	400	754	752	283	786	206	267	283	15	6	4,012
Little Powder River	534	47	818	4,230	4,222	1,586	1,669	218	323	1,586	20	8	15,261
Little Missouri River	0	0	0	0	0	0	0	0	0	0	0	0	0
Antelope Creek	474	38	2,076	14,732	14,695	5,524	1,504	127	298	5,524	25	10	45,027
Dry Fork Cheyenne River	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Cheyenne River	160	12	364	663	662	249	488	145	303	249	10	4	3,309
Lightning Creek	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Belle Fourche River	1,664	136	1,582	7,190	7,176	2,702	6,168	315	873	2,702	60	24	30,592
Middle North Platte River	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	10,474	903	12,965	51,486	51,372	19,312	32,685	3,682	8,877	19,312	660	264	211,992

Notes:

1. Disturbance includes the areal extent of direct discharge facilities, containment reservoirs, land application facilities, and injection wells. The ratios of water handling facilities applied to each sub-watershed are shown on Table 2–9.
2. Reciprocating (Recip.) compressors increase the compression of natural gas for delivery to high-compression transmission pipelines. Each station would consist of 1 to 6 recip compressors, depending upon the volume of gas being delivered to the station.
3. Booster compressors enhance the flow of gas from the wells to the recip compressors. Each station would consist of 1 to 6 booster compressors, depending upon the volume of gas being delivered to the station.

Source: BLM 2001e

Table 2–7 Summary of Estimated Long-term CBM Disturbance Associated with Alternative 1

			Roads		Poly Pipeline		Water Handling	Compressor Discharge Pipelines		Power Line	Compressor Stations		
Sub-watershed	Well Pads (acres)	CMFs (acres)	Improved (acres)	Two-track (acres)	2–3-inch (acres)	12-inch (acres)	Facilities[1] (acres)	Recip.[2] (acres)	Booster[3] (acres)	Overhead (acres)	Recip. (acres)	Booster (acres)	Total (acres)
Little Bighorn River	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Tongue River	259	24	708	2,083	0	0	3,120	0	0	261	25	10	6,490
Middle Fork Powder River	0	0	0	0	0	0	0	0	0	0	0	0	0
North Fork Powder River	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Powder River	1,897	174	4,973	14,556	0	0	12,423	0	0	1,820	415	166	36,424
South Fork Powder River	0	0	0	0	0	0	0	0	0	0	0	0	0
Salt Creek	4	0	78	351	0	0	34	0	0	44	5	2	518
Crazy Woman Creek	292	27	1,030	3,299	0	0	2,102	0	0	412	50	20	7,232
Clear Creek	375	35	936	3,628	0	0	4,391	0	0	453	35	14	9,867
Middle Powder River	96	9	400	754	0	0	786	0	0	94	15	6	2,160
Little Powder River	204	19	818	4,230	0	0	1,669	0	0	529	20	8	7,497
Little Missouri River	0	0	0	0	0	0	0	0	0	0	0	0	0
Antelope Creek	164	15	2,076	14,732	0	0	1,504	0	0	1,841	25	10	20,367
Dry Fork Cheyenne River	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Cheyenne River	54	5	364	663	0	0	488	0	0	83	10	4	1,671
Lightning Creek	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Belle Fourche River	593	55	1,582	7,190	0	0	6,168	0	0	901	60	24	16,573
Middle North Platte River	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	3,938	363	12,965	51,486	0	0	32,685	0	0	6,438	660	264	108,799

Notes:

1. Disturbance includes the areal extent of direct discharge facilities, containment reservoirs, land application facilities, and injection wells. The ratios of water handling facilities applied to each sub-watershed are shown on Table 2–9.
2. Reciprocating (Recip.) compressors increase the compression of natural gas for delivery to high-compression transmission pipelines. Each station would consist of 1 to 6 recip compressors, depending upon the volume of gas being delivered to the station.
3. Booster compressors enhance the flow of gas from the wells to the recip compressors. Each station would consist of 1 to 6 booster compressors, depending upon the volume of gas being delivered to the station.

Source: BLM 2001e

In general, the Companies would reclaim access roads not needed for production (e.g., access roads to plugged and reclaimed wells) as soon as practical. However, with the surface owner's concurrence the Companies could leave in place roads that have value for ranching or agricultural uses.

Well Pads

The minimum area required for a well pad would vary by company. Initially, the sizes of well pads would range from a minimum of 0.3 acre (100 feet by 150 feet) to a maximum of about 0.7 acre (175 feet by 175 feet). Upon the successful completion of a well, portions of the well pad not needed for production equipment and activities would be reclaimed. Over the long-term, the size of well pads would be reduced to a minimum of about 0.1 acre (75 feet by 75 feet) for pads with one well to about 0.3 acre (115 feet by 115 feet) for pads with three wells.

Construction at a well pad would be minimal. At level well pads, little clearing of vegetation or soil would occur. At each drill site, a temporary mud pit approximately 6 feet deep, 10 feet wide, and up to 30 feet long, would be excavated, used during drilling and completion operations, and then reclaimed.

In areas where the surface of the ground is too steep to allow a drill rig to set up over native ground, the Companies would use limited cut and fill construction techniques to level a work area. Use of cut and fill construction techniques for well sites may be necessary an estimated 20 percent of the time. Areas disturbed, but not needed for production, would be reclaimed as soon as practical after the conclusion of drilling.

Drilling

Upon completion of the access road and preparation of the well pad (if needed), a mobile drilling rig would be driven to the site and erected. Typically, the Companies use a truck-mounted water well type of drilling rig to drill CBM wells in the Project Area. Additional equipment and materials needed for drilling operations, including water, would be trucked to the site. On average, drilling would require about 26,000 gallons (0.08 acre-feet) of water per well for preparing cement, stimulating the well, controlling dust, and drilling (non-toxic drilling mud is required to handle certain down-hole conditions). Drilling mud usually is native mud and bentonite. As hole conditions dictate, small amounts of polymer additives and/or potassium chloride salts may be added for cleaning the hole and stabilizing clay.

The WOGCC and BLM currently require surface casing of 60 feet or 10 percent of the total depth of the well be set with cement returns to the surface. The drilling of individual wells proceeds as follows. A well is drilled to a depth of 350 feet to 1,500 feet or deeper to the top of a coal zone. The well control system is designed to meet the conditions likely to be encountered in the hole and would be in conformance with the BLM and State of Wyoming's requirements. At a minimum, the WOGCC and BLM require a diverter after surface casing is set.

Drilling and completion operations for a CBM well normally involves about 7 to 15, including personnel for logging and cementing activities. Each well would be drilled within one to three days. When the target coal is reached, well production casing would be placed and cemented. Placement of production casing (casing the hole) would include the insertion of a steel pipe into the drill hole from the bottom of the hole to the surface. Casing would be set into the hole one joint at a time and would be threaded at one end with a collar located at the other end, to connect each joint.

The casing would be cemented into place by pumping a slurry of dry cement and water into the casing head, down through the casing string to the bottom, and then up through the spacing between the casing and the well (annulus). A plug and water flush then would be pumped to the bottom of the well to remove any residual cement from the inside walls of the casing. Sufficient cement would be pumped into the annulus to fill the space where it would be allowed to harden.

A cement bond log would be run on the well to ensure no voids remain in the annulus. Cementing the annulus around the casing pipe restores the original isolation of formations by creating a barrier to the vertical migration of fluids and gas between rock formations within the borehole. It also protects the well by preventing formation pressures from damaging the casing and retards corrosion by minimizing contact between the casing and corrosive formation waters.

Once the cement sets up or hardens behind the casing, the coal zone would be drilled using either air or water. The size of the hole in the coal below the casing is enlarged using an upreamer bit that may extend out to an 18-inch diameter or more. The well would be completed “open hole” in the coal without placing any more steel casing in the hole.

After the coal zone is drilled, the open hole may be flushed with clean chlorinated water (from approved and properly permitted facilities) to remove the coal fines from the hole. Steel tubing then would be placed inside the casing and in the open hole. A submersible electric pump would be placed on the bottom end of the tubing to pump water from the coal. The size and capacity of the submersible pump would depend on the coal’s thickness and the rate of production expected from the well. Most pumps are rated at 10 to 20 gallons per minute (gpm). The water pressure in the coal zone must be reduced before gas (methane) will flow to the open hole. The water would be pumped up the tubing to the surface where, generally, it would be gathered in a pipeline for disposal. When the gas is released from the coal, it flows up the space between the tubing and the steel casing to the gas-gathering system and compressors at the surface.

Upon completion of the well, all disturbed areas not needed for production facilities would be restored. The mud pit would be dried and backfilled. Seeding of these areas takes place as soon as practicable.

Wells determined to be unsuccessful would be plugged, abandoned, and then reclaimed. Abandonment would follow the procedures set forth by the WOGCC and/or the BLM. Reclamation would be completed according to the BLM’s regulations and/or the surface owner agreement.

Well Production Facilities

After well productivity is established, a small area of about 5 to 6 feet square would be leveled and a weatherproof covering or box would be placed over the wellhead. Usually, a metal fence or rail would be placed immediately around the box and electrical panel to protect them from livestock. Meters to measure pressure and rates of water production may be placed in the box. There would be no pump jacks at the wellhead site; however, injection facilities, including some treatment facilities, likely would be collocated at CBM wells. The power lines for the submersible water pump would be laid in trenches, usually with water pipelines, and would not be placed on poles. This would minimize the surface disturbance and visual impact of the Proposed Action.

Pipelines

Three types of pipelines would be constructed as part of the Proposed Action. They are gas-gathering pipelines, produced water-gathering pipelines, and high-pressure gas delivery pipelines. The gas-gathering and produced-water gathering pipelines would conduct gas and produced water from the wells to compressor facilities and produced-water discharge or disposal points, respectively. The high-pressure gas pipelines would connect compressor facilities to the existing and proposed transmission pipelines. Rights-of-way for the pipelines would vary from 20 to 50 feet for polyethylene pipeline and 100 feet for steel pipelines.

All three types of pipelines would be installed along access roads to minimize disturbance, except where topography or concerns of surface owners dictate otherwise. Gas-gathering pipelines and produced water-gathering pipelines would be placed together in the same trench/ditch. High-pressure pipelines would be installed in a separate ditch. Gas and produced water-gathering pipelines would be constructed of polyethylene pipe with an outside diameter of 2 to 12 inches. The high-pressure pipelines would be constructed of steel pipe with an outside diameter of 12 to 16 inches.

Usually, the gas-gathering pipeline would be laid in a ditch constructed by a small mechanical belt-ditching machine. This method of construction would involve very little surface disturbance and the clearing of little or no vegetation. The construction right-of-way for gas-gathering pipelines would range from 20 to 50 feet. The actual width of the trench would range from 18 to 36 inches.

Generally, the construction of pipelines would occur in a planned sequence of operations and along roads where possible. Where feasible, trees would be avoided. Brush and woody vegetation would be left in-place and driven over as necessary (crushed but potentially capable of redeveloping a vegetative canopy). If necessary, the path would be cleared of trees and heavy brush by brush beating or lightly blading the surface. Soils would be left undisturbed over much of the construction work area, although some compaction may occur. Pipeline crossings of streams would be conducted according to the requirements of 404 permitting. Overall, the crossings would be constructed to minimize the length and the locations of the crossings would be returned to approximate original configurations. Reclamation would begin immediately after burying the pipeline.

Facilities for the Gathering and Disposing of Produced Water

Polyethylene pipe 2 to 3 inches in diameter would be connected to the tubing in the well and brought underground in a trench to a point of discharge into a natural drainage or disposal containment. The current average rate of water production per well, according to the WOGCC, is about 10 gpm (Likwartz 2001). This individual well rate may rise as deeper, thicker coals are produced. Higher rates are expected in the Powder River sub-watershed where the Big George Coal reaches a maximum thickness of about 200 feet. The Powder River drainage basin is expected to have nearly half of the wells drilled under this alternative. The Companies are aware of this issue and have already initiated watershed studies for dealing with water issues in three of the major tributaries of the Powder River where drilling is occurring or is about to occur. Historically, based on production information available on the WOGCC website, the water production rate from a new area where the water pressure is being reduced before gas production drops to one-half the initial rate after the first year's production. The maximum production rate over the entire Project Area is expected to occur in 2006 with about 381,000 acre-feet of water per year (Table 2–8).

The method of handling produced water would vary as the water quality, water volumes, and surface owner desires change. Potential water handling methods include direct surface discharge, treatment of produced water followed by direct surface discharge, containment of produced water, and injection of produced water through disposal wells (Table 2–9). Presently, the primary method of disposal is to bring the water via underground pipe to a surface discharge location mutually selected by the operator and the surface owner or lessee. Discharges are permitted by the WDEQ after the issuance of a National Pollutant Discharge Elimination System (NPDES) permit. The following sections describe the assumptions developed for the analysis of water handling

Surface Discharge Analysis Assumptions

Produced water from CBM wells would be gathered for discharge at outfalls. Surface discharge facilities of varying sizes would be constructed; however, for the purpose of this analysis an average facility, described below, was analyzed. On average, five wells would be discharged together at the same outfall. Outfalls may feed into small stock reservoirs or other treatment facilities before the outflows reach surface drainages. CBM produced water that is discharged to the surface may be suitable for irrigation use and may be diverted for that purpose. On average, all facilities associated with untreated or passively treated surface discharge for up to 20 CBM wells (estimated to be four "bubbler" outfalls, a stock pond, and an armored stream channel for the purpose of this analysis) would encompass an estimated 6 acres or approximately 0.3 acres per well. On average, all facilities associated with actively treated surface discharge for CBM wells also would encompass approximately 0.3 acres per well.

Infiltration Impoundments Analysis Assumptions

Produced water from CBM wells would be gathered for discharge into infiltration impoundments, where infiltration is selected as the water handling option because of concerns about the magnitude of increased surface flows or produced water quality. Infiltration impoundments of varying sizes would be constructed; however, for the purpose of this analysis an average impoundment encompassing

Table 2–8 Projected Amount of Water Produced from CBM Wells Under Alternatives 1, 2A, and 2B

	Water Produced (in acre-feet)[1]																
Sub-watershed	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
Little Bighorn River	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Tongue River	35,002	44,061	47,659	48,428	49,455	52,606	47,671	52,142	50,520	51,044	48,020	46,011	43,446	36,629	24,070	19,546	696,310
Middle Fork Powder River	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
North Fork Powder River	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Powder River	107,118	132,947	148,617	157,336	162,534	160,025	154,501	137,894	124,112	108,585	92,756	74,276	49,881	24,801	13,433	3,683	1,652,499
South Fork Powder River	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Salt Creek	60	107	119	118	129	126	123	62	40	26	16	0	0	0	0	0	926
Crazy Woman Creek	14,329	21,310	26,241	29,120	31,185	32,578	32,268	28,740	23,832	20,861	17,116	13,687	10,655	6,742	4,403	2,374	315,441
Clear Creek	24,467	39,632	49,641	58,210	66,116	70,983	70,323	68,746	65,343	61,663	54,485	46,526	38,472	30,578	19,586	10,601	775,372
Middle Powder River	11,133	10,618	9,662	8,209	7,266	7,204	6,810	6,902	6,902	6,806	4,850	3,222	1,924	954	321	156	92,939
Little Powder River	14,650	13,873	13,610	13,250	11,949	6,931	4,440	4,471	4,395	4,098	3,396	3,212	2,293	2,050	1,349	658	104,625
Little Missouri River	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Antelope Creek	6,753	7,586	8,775	9,241	9,552	9,899	9,543	9,141	8,473	7,800	7,175	6,277	5,072	3,921	2,665	1,973	113,846
Dry Fork Cheyenne River	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Cheyenne River	3,665	3,569	3,366	3,158	2,983	2,587	2,444	2,246	2,031	1,730	1,852	1,527	1,412	1,030	251	303	34,154
Lightning Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Belle Fourche River	47,192	44,376	42,397	40,996	39,827	35,340	29,670	28,398	26,866	25,991	22,194	18,758	15,358	7,512	6,536	2,794	434,205
Middle North Platte River	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	264,369	318,079	350,087	368,066	380,996	378,279	357,793	338,742	312,514	290,615	251,860	213,496	168,513	114,217	72,614	42,088	4,220,317

Note:

1. Volumes shown include produced water from pre-2002 wells as well as the new CBM wells.

Source: Applied Hydrology and Associates 2001c

Table 2–9 Assumed Water Handling Methods for CBM Wells Under Alternatives 1 and 3

	Water Handling Method[1,2,3]						
	NPDES-permitted Discharge						
Sub-watershed	Untreated Discharge (percent)	Passive Treatment (percent)	Active Treatment (percent)	Infiltration Impoundment (percent)	Containment Impoundment (percent)	LAD (percent)	Injection (percent)
Upper Tongue River	0	35	0	45	10	0	10
Upper Powder River	75	0	0	15	5	0	5
Salt Creek	55	0	0	35	5	0	5
Crazy Woman Creek	70	0	0	5	5	15	5
Clear Creek	25	10	0	40	5	10	10
Middle Powder River	60	5	0	10	10	10	5
Little Powder River	65	0	0	10	10	10	5
Antelope Creek	55	0	0	35	5	0	5
Upper Cheyenne River	55	0	0	35	5	0	5
Upper Belle Fourche River	45	0	0	40	5	0	10

Notes:

1. The percentages shown represent the distribution of water handling methods assumed for the analysis, not the amount of water that actually reaches the river.
2. Handling Methods:
   NPDES-permitted Discharge – includes methods of handling the produced water that require an NPDES permit.
   Untreated discharge – water that is discharged onto the surface of the ground or into drainages tributary to perennial waters of the state without any treatment.
   Passive treatment – water that is amended through passive methods to meet standards before discharge. An example of this method is passing the water over scoria to remove iron.
   Active treatment – water that is amended through active methods to meet standards before discharge. An example of this method is passing the water through a reverse osmosis system.
   Infiltration impoundment – water contained in upland and bottomland impoundments designed for maximum infiltration and groundwater recharge.
   Containment impoundment – includes upland impoundments, both lined and unlined, with minimal infiltration and no direct surface discharge or lateral subsurface movement of water and down-gradient expression in seeps or springs. These impoundments would be permitted by either the WOGCC or DEQ, depending on which agency has jurisdiction for the specific impoundment.
   LAD = land application disposal. Typically, land application is achieved by spraying produced water through agricultural irrigation equipment and high-pressure atomizers.
   Injection – represents that water that is injected into disposal wells.
3. The above percentages are not upper thresholds that can or would be enforced. They are merely a disclosure of effects of one of many various ways water may be handled to meet the Montana/Wyoming agreement of water quality levels at the state line.

6 acres and having a capacity of approximately 48 acre-feet was analyzed. Also, for the purpose of this analysis, CBM wells are projected to produce water at the rate of 9.5 gpm during their productive life.

Shallow impoundments having a dam height, on average, of 13 feet would be constructed in bottomland and upland areas in a manner that allows infiltration and prevents surface discharge. In some cases, the bottom surface of an impoundment area may contain key trench-type excavations or closely spaced boreholes to enhance infiltration. Evaporation would be enhanced using atomizers placed on towers situated on floating islands, with spray from these units directed above the water surface only.

Upland Areas – For the purpose of this analysis, each impoundment constructed in an upland area, on average, would encompass an estimated 6 acres (48 acre-feet capacity), containing all water produced over the life of the CBM wells undergoing infiltration, and disturbing an estimated 1.6 acres per well undergoing infiltration. On average, each impoundment would contain all of the produced water from five CBM wells. In most cases, impoundments would not be constructed as flow-through structures. All surface and overland flows likely would be diverted away from the impoundments. Where surface flows are not diverted, impoundments would be designed to hold, pass through, or flush contents and surface flows, based on a design event. Livestock and wildlife would not be fenced out. The impoundments would not be netted. On average, enhanced evaporation would reduce the water impounded by an estimated 4 feet per year. On average, infiltration would reduce the water impounded by an estimated 8 feet per year (AHA and Greystone 2001).

Bottomland Areas - Each impoundment constructed in a bottomland area, on average, would encompass an estimated 6 acres (48 acre-feet capacity), containing all water produced over the life of the CBM wells undergoing infiltration, and disturbing an estimated 1.6 acres per well undergoing infiltration. On average, each impoundment would contain all of the produced water from five CBM wells. If enhanced evaporation and infiltration methods are successful, each impoundment could contain all the produced water from up to 10 wells. Impoundments likely would be constructed within or near drainages, floodplains, and gravelly terraces, and may be constructed as flow-through structures. All surface and overland flows may be diverted away from the impoundments. Where surface flows are not diverted, impoundments would be designed to hold, pass through, or flush contents and surface flows, based on a design event. Livestock and wildlife would not be fenced out. The impoundments would not be netted. On average, enhanced evaporation would reduce the water impounded by an estimated 4 feet per year. On average, infiltration would reduce the water impounded by an estimated 8 feet per year (AHA and Greystone 2001).

Containment Analysis Assumptions

Produced water would be gathered for discharge into containment impoundments, where containment (no discharge to surface drainages and minimal infiltration) is selected as the water handling option because of poor quality of the CBM produced water. Large containment reservoirs of varying sizes would be constructed; however, for the purpose of this analysis an average impoundment encompassing 100 acres and having a capacity of approximately 2,000 acre-feet was analyzed. These reservoirs would be constructed in upland areas, away from drainages, floodplains, and gravelly terraces, and would not be constructed as flow-through impoundments. All surface and overland flows would be diverted away from the reservoirs. Livestock and wildlife may be fenced out if water quality does not meet recommendations for these uses. The reservoirs would not be netted, as that would not be feasible, given the size of the impoundments.

Each of these reservoirs would contain all of the produced water from 60 wells, over the life of the wells. For the purpose of this analysis, CBM wells are projected to product water at the rate of 9.5 gpm, on average, over their productive life. Each reservoir would encompass a surface area of about 100 acres, would be about 8 feet deep at the end of 3 years, and would be 20 feet deep at the end of 10 years (design capacity). The total disturbed area for each reservoir would be about 140 acres, or about 2.3 acres per well. The dam would be 25 feet high, to allow for freeboard of 5 feet. Embankment slopes would be 1:3 and would include a 12 feet wide flat area along the top of the embankment to allow for heavy equipment. Generally, about one half of the reservoir would be excavated below the natural ground level.

Atomizers would be located on towers situated on floating islands in the central portions of the reservoir. Spray from these units would be directed above the water surface only so that the land surface near the reservoir would be unaffected. On average, enhanced evaporation would reduce the water impounded by an estimated 4 feet per year. On average, infiltration would reduce the water impounded by an estimated 0.75 feet per year (10 percent).

Land Application Disposal Analysis Assumptions

All water produced over the life of 40 wells would be spread on the land surface of a land application disposal (LAD) site using mobile atomizers or irrigation equipment. All water would be contained within the LAD site. An estimated 100 percent of the water would be used consumptively. Infiltration and channelized surface runoff would be negligible. For the purpose of this analysis, each LAD site would disturb an estimated 64 acres or an estimated 1.6 acres per well.

Disposal likely would be accomplished using a disposal-rest rotation cycle consisting of disposal, soil amendment, rest, disposal… until the limitations of repeated soil amendments are reached, and a portion of the site would be reclaimed.

The LAD facilities would be associated with an impoundment. During periods when the water could not be applied (e.g., winter or equipment malfunction), the water would be stored in the impoundment. The impoundments are addressed in the previous sections on surface discharge, infiltration and containment.

Injection Analysis Assumptions

Produced water from 6 to 10 CBM wells would be gathered for injection into the Fort Union Formation or a lower injection zone. For the purpose of this analysis, on average, injection well facilities, including water transfer facilities, flowlines, and roads serving 8 CBM wells would disturb an estimated 12 acres, or approximately 1.5 acres per well.

Central Metering Facilities

Typically, natural gas produced from each well is individually measured and mechanically or electronically recorded at a central point or central metering facility (CMF). Gas-gathering pipelines for an average of ten wells would be tied together in a CMF, where metering for all the connected wells would occur. At the CMF, gas would be commingled into the gas-gathering system, which would transport it to the compressor station. An improved road would be constructed to each CMF, which would disturb an area no wider than 50 feet. Construction of each CMF would disturb about 0.2 acre (100 feet by 100 feet) for the short term. This disturbance would be reduced to about 0.1 acre (50 feet by 80 feet) for the long term.

The wells connected to a CMF may produce water for some time (occasionally more than a year) before natural gas (methane) is produced. The water produced would be disposed of using methods that meet standards of the WDEQ, BLM, WOGCC, and WSEO. Small amounts of gas may be produced in the initial stages of de-pressuring the coal bed. This gas may be vented until sufficient volumes are produced to run a first stage compression system near the CMF. Any venting would be done according to the BLM's Notice to Lessees 4A (Royalty or Compensation for Oil and Gas Lost), and Onshore Order No. 5 (Measurement of Gas) and by permission of the WOGCC and BLM in Sundry Notices. Immediately upon reaching a volume capable of sustaining compression operations, the wells producing gas would be shut in until the necessary pipeline connections are made.

Natural gas (methane) production is expected to reach a maximum rate for the entire Project Area of almost 3.6 billion cubic feet per day (bcf) in 2006 and 2007. Current total recoverable reserve estimates range from 13 to 25 trillion cubic feet of gas (BLM 2001f). Other estimates suggest total recoverable reserves range from 12 to 37 trillion cubic feet of gas (Crockett et al. 2001).

Electrical Power Utilities

Although the Companies would use gas-fired compressors, other equipment, such as pumps, would be electric. In addition, natural gas-fired and diesel engine-powered generators may be used temporarily at individual wells until electrical distribution lines are constructed.

Based on projected power demands, it is anticipated that the Companies would require 0.5 megawatt (MW) per day to transport 3 bcf of natural gas per day using gas-fired compression. Based on this power demand, the maximum power requirement would be 0.6 MW per day.

Under this alternative, three-phase 24.9-kilovolt (kV) distribution lines would connect wells and compressor facilities with the existing transmission and distribution system within the Project Area. Electricity would be routed to compressor stations and CMFs aboveground on poles generally located along the access roads or on additional rights-of-way (30 feet wide) across open land. Between the CMFs and wells, the secondary electric service power lines (480 volt) would be buried in the same trenches with the gas- and produced water-gathering pipelines. The installation and power would be provided by the utility company providing these services. Construction of the power lines would follow access road development and coincide with the completion of well drilling. The power lines would be designed and constructed according to the Avian Power Line Interaction Committee's (1996) guidelines for the prevention of electrocution of raptors.

The aboveground power lines would be constructed using tracked and wheeled equipment. Holes for the poles would be located so as to not disturb existing sensitive vegetation and would be excavated to a depth of 6 to 8 feet. Poles and other structural components would be transported to the construction site where they would be assembled and then erected by a boom truck.

Pole locations could be moved if topography and/or impacts to cultural, vegetative, or wildlife resources are identified at the site of the structure. In areas of thick vegetation and/or where vegetation may impede the performance of the active line, vegetation would be cleared, typically with hand-held equipment.

All aboveground electric lines typically would be installed on 35-foot tall poles. Poles would be required approximately every 300 feet. Approximately 5,311 miles of aboveground power lines would be installed in the Project Area (Table 2–5). The short-term surface disturbance for these lines would be 19,312 acres (Table 2–6). The long-term surface disturbance for the power lines would be 6,438 acres (Table 2–7).

Gas-Delivery System

The gas-delivery system consists of components that would deliver gas produced from the wells (Table 2–10) to the high-pressure transmission pipelines through which the gas would be transported to market. These components include compressor stations and pipelines. This section describes these primary components of this gas-delivery system.

The Companies would construct two types of compressor stations. They are central reciprocating and booster stations. Produced natural gas under pressure from the wellhead would move through the low-pressure gas-gathering system to a booster compressor station. Typical gathering line pressure is less than 50 pounds per square inch (psi). At booster stations, low (350) horsepower (HP) natural gas or electric-powered boosters or blowers would enhance the flow of gas through certain pipelines. As shown on Table 2–11, the Companies expect to construct almost 1,060 new booster compressors. These compressors would be distributed among as many as 186 stations (Table 2–12).

Gas from the booster compressor stations would flow through medium pressure pipelines (50 to 125 psi) to the central reciprocating compressor stations. At these stations, high horsepower (1,650 HP) compressors would increase the pressure of natural gas to an estimated 700 to 1,450 psi to facilitate transmission of the natural gas to high-pressure transmission pipelines. As shown on Table 2–13, the Companies expect to construct almost 298 new reciprocating compressors. These units would be distributed among as many as 63 new stations (Table 2–14).

The compressor sites would be constructed in steps. After obtaining all necessary permits, an access road would be constructed from an existing road to the site. Vegetation would be cleared and topsoil would be stripped and stockpiled. An area of about 2 acres (for booster stations) or 5 acres (for reciprocating stations) would be graded using standard cut-and-fill construction techniques and machinery (bulldozer and/or grader). Concurrent with construction of the compressors, gas pipelines would be built to the site. Also, clear lamp lights (250 watts each) would be installed to light each compressor facility. Each light would be mounted on a pole or building and directed downward to illuminate key areas within the facility while minimizing the amount of light projected outside the facility.

Table 2–10 Projected Amount of Natural Gas Produced from CBM Wells Under Alternative 1

	Total Cubic Feet of Methane Produced per Day by Year (in mmcf)									
Sub-watershed	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Little Bighorn River	0	0	0	0	0	0	0	0	0	0
Upper Tongue River	22	36	56	72	84	89	91	92	92	92
Middle Fork Powder River	0	0	0	0	0	0	0	0	0	0
North Fork Powder River	0	0	0	0	0	0	0	0	0	0
Upper Powder River	1,078	1,705	2,056	2,284	2,319	2,301	2,225	1,905	1,317	819
South Fork Powder River	0	0	0	0	0	0	0	0	0	0
Salt Creek	7	11	13	15	15	14	14	12	8	4
Crazy Woman Creek	96	157	196	224	233	234	230	206	160	120
Clear Creek	56	88	115	135	147	152	155	154	147	141
Middle Powder River	8	12	18	22	26	27	27	27	27	27
Little Powder River	56	82	95	103	106	107	108	105	92	81
Little Missouri River	0	0	0	0	0	0	0	0	0	0
Antelope Creek	80	120	137	147	147	145	141	123	91	63
Dry Fork Cheyenne River	0	0	0	0	0	0	0	0	0	0
Upper Cheyenne River	30	45	51	55	55	56	56	55	48	42
Lightning Creek	0	0	0	0	0	0	0	0	0	0
Upper Belle Fourche River	280	398	440	460	456	453	448	407	314	231
Middle North Platte River	0	0	0	0	0	0	0	0	0	0
Total	1,713	2,654	3,177	3,517	3,588	3,578	3,495	3,086	2,296	1,620

Source: Jones 2001

Table 2–11 Distribution of New Booster Compressor Units by Year and Sub-watershed — Alternative 1

Sub-watershed	Year 2002	2003	2004	2005	2006	2007	2008	Total
Little Bighorn River								
Upper Tongue River	3	6	8	6	5	2	1	31
Middle Fork Powder River								
North Fork Powder River								
Upper Powder River	195	250	141	91	14			691
South Fork Powder River								
Salt Creek	1	2	1					4
Crazy Woman Creek	17	24	16	11	4			72
Clear Creek	10	13	11	8	4	2	1	49
Middle Powder River	2	1	3	1	2			9
Little Powder River	9	10	5	4	1		1	30
Little Missouri River								
Antelope Creek	14	15	7	4				40
Dry Fork Cheyenne River								
Upper Cheyenne River	6	5	3	1	1			16
Lightning Creek								
Upper Belle Fourche River	47	47	17	7				118
Middle North Platte River								
Total	304	373	212	133	31	4	3	1,060

Source: BLM 2001e

Table 2–12 Distribution of Booster Compressors by Size of Station and Sub-watershed — Alternative 1

Sub-watershed	Booster Stations 1-Unit	2-Unit	3-Unit	4-Unit	5-Unit	6-Unit	Total
Little Bighorn River							
Upper Tongue River			1	1		4	6
Middle Fork Powder River							
North Fork Powder River							
Upper Powder River			1	1		114	116
South Fork Powder River							
Salt Creek	1		1				2
Crazy Woman Creek						12	12
Clear Creek			2			7	9
Middle Powder River	1	1	2				4
Little Powder River			2			4	6
Little Missouri River							
Antelope Creek		1		1		6	8
Dry Fork Cheyenne River							
Upper Cheyenne River				1		2	3
Lightning Creek							
Upper Belle Fourche River				1		19	20
Middle North Platte River							
Total	2	2	9	5	0	168	186

Source: BLM 2001e

Table 2–13 Distribution of New Reciprocating Compressors by Year and Sub-watershed — Alternative 1

	Year							
Sub-watershed	2002	2003	2004	2005	2006	2007	2008	Total
Little Bighorn River								
Upper Tongue River	1	2	2	1	2		1	9
Middle Fork Powder River								
North Fork Powder River								
Upper Powder River	54	70	39	25	4			192
South Fork Powder River								
Salt Creek		1						1
Crazy Woman Creek	5	7	4	3	1	1		21
Clear Creek	3	3	3	3	1		1	14
Middle Powder River		1		1			1	3
Little Powder River	3	3	1	1			1	9
Little Missouri River								
Antelope Creek	3	5	2	1				11
Dry Fork Cheyenne River								
Upper Cheyenne River	2	1	1	1				5
Lightning Creek								
Upper Belle Fourche River	13	13	4	3				33
Middle North Platte River								
Total	84	106	56	39	8	1	4	298

Source: BLM 2001e

Table 2–14 Distribution of Recipricating Compressors by Size of Station and Sub-watershed — Alternative 1

	Reciprocating Stations						
Sub-watershed	1-Unit	2-Unit	3-Unit	4-Unit	5-Unit	6-Unit	Total
Little Bighorn River							
Upper Tongue River			1			1	2
Middle Fork Powder River							
North Fork Powder River							
Upper Powder River			6			29	35
South Fork Powder River							
Salt Creek	1						1
Crazy Woman Creek			3			2	5
Clear Creek		1	2			1	4
Middle Powder River			1				1
Little Powder River			3				3
Little Missouri River							
Antelope Creek		1	1			2	4
Dry Fork Cheyenne River							
Upper Cheyenne River		1	1				2
Lightning Creek							
Upper Belle Fourche River			1			5	6
Middle North Platte River							
Total	1	3	19	0	0	40	63

Source: BLM 2001e

Presently, the Companies propose to use natural gas fired compressors at all locations. As development of the Project Area matures, the use of natural gas-fired compressors may diminish and selected units may be constructed with electric-powered compressors. Because the likelihood and extent of this replacement are unknown, the impact analysis documented for Alternative 1 in this EIS assumed all compressors would be fired by natural gas. All compression internal combustion engines, any dehydration units, and any other emission sources must be permitted with the WDEQ's Air Quality Division.

Glycol dehydration units also would be installed at each reciprocating compressor site. The dehydration units would be used to reduce the water in the gas stream to acceptable levels for commercial transportation. The units would have a design flow rate that would accommodate the compression capacity of that station.

High-pressure gas delivery pipelines connecting reciprocating compressor stations with existing and new transmission pipelines would be located along existing roads wherever possible. Disturbance related to these delivery lines is expected to be confined to areas not wider than 100 feet, located within rights-of-way already established, wherever possible.

A variety of high-pressure gas pipelines currently serves the Powder River Basin (Table 2–15). Separately and in combination, these high-pressure systems deliver gas into other high-pressure pipeline systems that are part of the U.S.' natural gas grid. These downstream pipelines are classified as "interstate pipelines". The interstate pipeline companies currently taking gas away from the Powder River Basin are Williston Basin Interstate, Wyoming Interstate Company, Ltd., KM Interstate Pipeline Company, and Colorado Interstate Gas Company.

Table 2–15 Summary of High-pressure Pipelines Currently Operating in the Powder River Basin

Pipeline	Capacity (thousand cubic feet per day)
Fort Union Gas Gathering Company, L.L.P	634,000
Thunder Creek Gas Gathering Company, L.L.P	450,000
Big Horn Gathering Company, L.L.P.	450,000
Bittercreek Gathering Company	0
MIGC, Inc.	130,000
KMGGC, Inc.	140,000
Total	1,804,000

Although Thunder Creek Gas Gathering Company, L.L.P. has not announced any expansion, prior statements by the company suggest the Thunder Creek system could be expanded to a capacity of at least 700,000 million cubic feet (mmcf)/day.

The four interstate pipeline companies or other interstate pipeline companies may seek to expand their systems as the deliverability of CBM gas from the Powder River Basin grows. The expansion of any interstate pipelines would be subject to approval by the Federal Energy Regulatory Commission (FERC). As part of the certification process for any new interstate facilities, FERC's rules and procedures require extensive pre-certification environmental review of such projects. The FERC can condition its approval of new interstate projects with such environmental mitigation practices as indicated by the review of the individual project.

Workforce Requirements

Most of the active workforce involved in developing the Proposed Action would be involved in construction-related activities. After roads and well pads are constructed, pipelines and utility lines are installed, and wells are drilled and completed, minimal personnel would be required to operate the field. Table 2–16 shows the estimated employment requirements for the construction, operation, and reclamation of the project under the Proposed Action.

Construction Resource Requirements

Construction of the project would require a variety of materials and equipment. The primary materials would be water, sand, and gravel. Additionally, small amounts of chemicals would be required. Equipment needed for construction would include heavy equipment (bulldozers, graders, track hoes, trenchers, and front-end loaders) and heavy- and light-duty trucks.

Water would be needed for constructing roads, pipelines, and compressor stations. It also would be needed for drilling wells. Overall, the requirement for water to construct the Proposed Action is expected to be about 6,896 acre-feet (Table 2–17). This water would be obtained from local sources.

Production and Maintenance

Roads

Routine maintenance in the Project Area would occur on a year-round basis or as ground and site conditions permit. This maintenance program includes postponing travel on the two-track roads during and immediately after wet weather when vehicular traffic could cause rutting. Summer (late spring to early fall) road maintenance could include the addition of gravel and/or blading of improved roads consistent with "traveled road maintenance operations" in the area. Other routine maintenance could include borrow ditch grading and culvert and low-water crossing cleanout. Noxious weeds also would require yearly control along roads. Winter (late fall to early spring) maintenance would include blading of snow from access roads and some summer-like maintenance when necessary and permitted by weather conditions. During production and maintenance, the Companies would not routinely employ dust abatement procedures on roads within the Project Area.

Table 2–16 Estimated CBM Employment Requirements for Alternative 1

Work Category	Time Requirements per Unit	Number of Units	Personnel Required (# per year)	Workdays for Project	Workdays per Year	Average # of Workers per Day
Construction and Installation						
Access Roads	1 day/mile	17,276	2	34,552	3,455	14
Well Pads	0.5 day/pad	25,997	1	12,998	1,300	5
Pipelines	2 days/mile	20,474	3	94,164	9,416	39
Electrical Utility Lines	2 days/mile	5,311	5	53,110	5,311	22
Drilling and Casing	4 days/well	39,367	5	787,340	78,734	328
Well Completion	2 days/well	39,367	5	393,670	39,367	164
Compressor Facilities	21 days/compressor	970	28	570,360	57,036	238
Surface Discharge Fac.	5 days/pond	1,216	4	24,320	2,432	10
Infiltration Facilities	30 days/impound.	1,821	6	327,780	32,778	137
Containment Impound.	365 days/impound.	37	7	94,535	9,454	39
Injection well	6.5 days/well	285	6	11,115	1,112	5
Total				2,403,944	240,395	1,001
Operation and Maintenance						
Road/Pad Maintenance	1 days/well	39,367	1	39,367	1,968	8
Pumpers	20 days/well	39,367	1	787,374	39,367	164
Office	2.5 days/well	39,367	2	196,835	9,842	41
Well Workover	4 days/well	39,367	5	787,340	39,367	164
Surface Discharge Fac.	1 day/pond	1,216	1	1,216	61	0.3
Infiltration Facilities	1 day/facility	1,821	1	1,821	91	0.4
Containment Impound.	1 day/facility	37	1	37	4	0.1
Injection well	1 day/well	285	1	285	14	0.7
Total			13	1,814,275	90,714	379
Decommissioning/Reclamation						
Wells	2 days/well	39,367	2	157,468	15,747	66
Roads	2 days/mile	17,276	1	34,552	3,455	14
Compressor Stations	100 days/compressor	970	10	970,000	97,000	404
Reclamation	5 days/facility	313	3	4,695	470	2
Surface Discharge Fac.	2 days/pond	1,216	3	7,296	2,432	10
Infiltration Facilities	10 days/facility	1,821	13	236,730	23,673	99
Containment Impound.	60 days/facility	37	7	15,540	1,554	6
Injection well	2 days/well	285	2	1,140	114	0
Total			41	1,427,421	144,445	601

The counties and Companies would primarily be responsible for maintaining the project’s improved roads in the Project Area. The counties would continue to maintain existing county roads. The Companies would maintain all other project roads.

Upon the project’s completion, all roads constructed specifically for the project would be removed and reclaimed, unless retention of a road is specifically requested by the landowner or county. If a landowner decides to keep a road, then the landowner would accept responsibility for maintaining the road upon abandonment by the Companies. The counties would continue to maintain existing county roads and any roads covered by maintenance agreements with the BLM.

Table 2–17 Summary of Sand, Gravel, and Water Requirements for Alternative 1

Facility	Amount	Unit	Rate	Total Volume
Sand and Gravel				
Improved roads	6,657	miles	1,173 yd^3/mile	7,808,661
CMFs	394	CMFs	30 yd^3/CMF	11,820
Compressors	313	stations	1,100 yd3/station	344,300
Total (yd^3)				8,164,781
Water				
Roads	17,276	miles	0.1 acre-feet/mile	1,728
Pipelines	1,036	miles	0.04 acre-feet/mile	41
Well drilling	39,367	wells	0.08 acre-feet/well	3,149
Well completion	39,367	wells	0.05 acre-feet/well	1,968
Compressors	970	Compressor	0.01 acre-feet/compressor	10
Total (acre-feet)				6,896

Wells

Routine Maintenance A maintenance person (a "pumper") may visit each well up to once per day to ensure the equipment is functioning properly. Automated well monitoring equipment already in operation allows the pumper to visit less frequently depending on well location, reliability, and other factors. Field personnel would routinely calculate balances between wells and collection/transfer points to ensure volumes match within acceptable tolerances. Significant leaks in gas or water pipelines would cause a loss of pressure detectable by the static pressure on the meter run. If such a leak is detected, a well would be shut-in. The shut-in point would be determined for each well based upon individual operating conditions. Field leaks would then be pinpointed using field pressures and the problem would be corrected. Maintenance of the various mechanical components of the gas production would occur at intervals recommended by manufacturers or as needed based on site visits.

Additional remote (off-site) computerized monitoring system may be installed if warranted by the number of total producing wells and cost effectiveness. If installed, the automated monitoring system would allow remote monitoring of operations at each well. The system would monitor various operating conditions (e.g., gas and water production rates, pipeline pressure, and separator pressure) to determine if abnormal conditions exist. Electrical cables laid to the wells would provide power to the well site automation equipment. The well site operating conditions would be transmitted via radio to a local central facility. If a problem is identified, maintenance personnel would be immediately dispatched to the well site. The radio-controlled system would allow real-time signals and solutions in response to well production problems. Control and monitoring of well production by radio telemetry would reduce regular site inspections of each well and would limit vehicular traffic to approximately once a week to each well. However, other factors, such as the need for visual inspection of gas and water pipelines, may require daily visits for safety and environmental reasons.

Workovers Periodically, a workover on a well would be required. A workover uses a truck-mounted unit similar to a completion rig to ensure that the well is maintained in good condition and is capable of extracting natural gas as efficiently as possible. Workovers are typically needed within the first few months after initial completion to remove coal fines from pumps. Workovers can include repairs to the well bore equipment (casing, tubing, rods, or pumps), the wellhead, or the production formation. These workovers may require venting pressure relief. Routine repairs would occur only during daylight hours and are usually completed within one day. Some limited situations may require several days to complete a workover. Although the frequency of workovers cannot be predicted because the requirements for workovers vary from well to well, each new well would likely require a workover during the first year of production.

Pipelines

Routine inspection of gas-gathering and produced water pipelines would be done during the inspections of facilities. Procedures would be incorporated with the inspection of meters at the well sites. If pressure losses are detected, the wells would be shut in until the problem is isolated and addressed.

Electrical Utilities

Routine inspection and maintenance of electric utilities would be done by utility provider.

Decommissioning and Reclamation

The reclamation of dry holes would follow the procedures described below with the exception that reclamation would begin as soon as possible after the determination is made that the well would not be a producing well or that it is depleted of gas. The following sections describe the overall procedures the Companies would follow to reclaim the disturbance to as near as possible to pre-development conditions.

Roads

At a minimum, access roads would be reclaimed by ripping/plowing and drill seeding unless the landowner and/or land manager wishes to make use of any roads and accepts responsibility through execution of a release for future road maintenance. Improved roads not needed for further use would be blocked, recontoured, reclaimed and vegetated consistent with the requirements of the federal land managers (according to Onshore Oil and Gas Order No. 1, Approval of Operations) and the State of Wyoming. On private lands, the Companies would execute release of the road to the landowner or reclaim it according to the terms of surface use agreements that may be in effect at that time.

All road disturbances on federal lands would be reseeded with a seed mixture approved by the Authorized Officer, as described in the APD Surface Use Program or COAs. The seed mixture would be planted in the amounts specified in pounds of pure live seed per acre. All seed would be certified as weed free. Seed would be tested in accordance with state laws and within 12 months before purchase. Commercial seed either would be certified or registered seed. Seeding and/or planting would be repeated until satisfactory revegetation is accomplished. Multi-year noxious weed control may be needed on some reclaimed areas.

Wells

All surface facilities would be removed. Depleted production holes would be plugged and abandoned in accordance with Onshore Oil and Gas Order No. 2 and WOGCC's rules. Once the well is conditioned as a static column, the well would be decommissioned by placing redundant plugs, a slurry of cement and water, at strategic locations in the well bore. These locations would be based upon each well's configuration, but would be placed to prevent the migration of fluids or gas up the well bore or any uncemented paths. A mixture of bentonite and water would be placed between the cement plugs. Well pads would be recontoured, plowed, and seeded consistent with the procedures described in the APD Surface Use Program or COAs. The Companies also may assign wells to the landowner consistent with the terms of the surface use agreement. Upon assignment, all rights and responsibilities, including reclamation, pass to the landowner, unless otherwise specified. The landowner must then properly permit the well for beneficial uses after CBM production has ceased according to the WSEO's statutes, procedures, and policies.

Pipelines

The procedures for decommissioning and reclaiming pipelines are straightforward. The underground pipelines would be cleaned, disconnected, and then abandoned in place to avoid any unnecessary surface disturbance as noted in the COAs for the APD or the POD for the ROW or SUP. Any surface disturbances associated with the underground pipelines are addressed in previous sections.

Electrical Utilities

Underground electric lines would be disconnected and abandoned in place to avoid any unnecessary surface disturbance. Aboveground lines would be disconnected and the power poles would be removed from the sites. Surface disturbance associated with the removal would be reclaimed according to the COAs for the APD or the POD for the ROW or SUP.

Non-CBM Development

The BLM has evaluated the potential for the occurrence and development of non-CBM oil and gas resources in the Project Area. In part, this evaluation resulted in the mapping of various levels of potential (e.g., very low, low, moderate, or high) within the Buffalo Field Office Area (BFOA). It also resulted in three levels of potential development, which are documented in the BLM's RFD Scenario for the Buffalo Field Office (BLM 2001f).

The moderate level of development under the BLM's RFD Scenario, which is the basis for this alternative, projects the drilling and completion of about 3,200 non-CBM wells within the Project Area over the 10-year period. As shown on Table 2–18, 3,000 of these wells would be drilled in the portion of the Project Area under the jurisdiction of the Buffalo Field Office (BFO) and FS. The other 200 wells would be drilled in the portion of the Project Area under the jurisdiction of the Casper Field Office (CFO).

Table 2–18 Projected Distribution of Non-CBM Wells Under Alternative 1

	Potential for Oil and Gas				
Sub-watershed	Very Low	Low	Moderate	High	Total
Buffalo Field Office Area and TBNG					
Little Bighorn River	2	0	0	0	2
Upper Tongue River	7	28	0	0	35
Middle Fork Powder River	20	3	0	0	23
North Fork Powder River	1	0	0	0	1
Upper Powder River	0	25	374	0	399
South Fork Powder River	3	3	0	0	6
Salt Creek	0	3	20	0	23
Crazy Woman Creek	1	19	5	0	25
Clear Creek	1	26	0	0	27
Middle Powder River	0	2	57	41	100
Little Powder River	0	0	161	1,358	1,519
Little Missouri River	0	0	4	92	96
Antelope Creek	0	1	82	0	83
Upper Cheyenne River	0	5	35	0	40
Upper Belle Fourche River	0	5	215	401	621
Total	35	120	953	1,892	3,000
Casper Field Office Area					
Converse County					200
Total					3,200

Surface disturbance for a typical oil well (from 5,000 to 12,000 feet deep) includes 4 acres for the well pad and 1.5 acres for a 1-mile long bladed road for a total of 5.5 acres disturbed for drilling operations. Part of the well pad area is reclaimed as production operations begin. The entire area of disturbance is reclaimed when the well is plugged and abandoned.

As shown on Table 2–19, almost 17,600 surface acres of the Project Area may be disturbed by the construction of non-CBM wells. Most of this disturbance would occur in three sub-watersheds. They are Little Powder River, Upper Belle Fourche River, and Upper Powder River. Once the wells are operational and partial reclamation has occurred, long-term disturbance would encompass about 82 percent of the original disturbance.

The non-CBM development also would require a workforce involved in construction-related activities. After roads and well pads are constructed and wells are drilled and completed, minimal personnel would be required to operate the field. Table 2–20 shows the estimated employment requirements for the non-CBM wells.

Safety/Emergency Response

This section outlines the methods that the Companies would employ to ensure the safe operation of the oil and gas wells during development and production. It also describes how the Companies would respond to emergencies. In cooperation with the WOGCC and Wyoming Occupational Safety and Health Administration, the Companies have undertaken a comprehensive study of safety regulations currently in place related to the development and will recommend to the agencies of jurisdiction any changes deemed necessary to protect the health and safety of the public as well as those employed in the development.

Table 2–19 Projected Maximum Disturbance Due to Non-CBM Wells Under Alternative 1

	Areal Extent of Disturbance	
Sub-watershed	Short-term (acres)	Long-term (acres)
Buffalo Field Office Area and TBNG		
Little Bighorn River	11	9
Upper Tongue River	193	158
Middle Fork Powder River	126	104
North Fork Powder River	6	4
Upper Powder River	2,194	1,796
South Fork Powder River	33	27
Salt Creek	126	104
Crazy Woman Creek	138	112
Clear Creek	148	122
Middle Powder River	550	450
Little Powder River	8,354	6,836
Little Missouri River	528	432
Antelope Creek	456	374
Upper Cheyenne River	220	180
Upper Belle Fourche River	3,416	2,794
Total	16,499	13,502
Casper Field Office Area		
Converse County	1,100	900
Total	17,599	14,402

Note:
Maximum disturbance is based on 5.5 acres and 4.5 acres per well for short-term and long-term disturbances, respectively.

Geologic Hazards

During drilling operations, abnormally-high formation pressure could be encountered, which could result in an uncontrolled well condition. However, more than 6,000 CBM wells have been drilled in the Project Area with no instances of abnormally-high pressure. Blowouts are considered highly unlikely due to the shallow depths of the wells, normal and below normal pressures in the formations, and past experience in the Project Area. The WOGCC and BLM require diverters after setting surface casing.

Fires and Explosions

The potential for leaks or ruptures in gas flowlines or pipelines would exist. Most ruptures are the result of heavy equipment accidentally striking the pipeline while operating in close proximity. Such ruptures could result in an explosion and/or fire if a spark or open flame ignites the escaping gas. The design and selection of materials used in the pipelines would be conducted in accordance with applicable standards to minimize the potential of a leak or rupture. Frequent markers along the pipelines would reduce the risk of accidental ruptures from excavating equipment. Additionally, the Companies would monitor the pipeline flow by either remote sensors or daily inspections of the flow meters, which would reduce the probability of ruptures by prompt detection of leaks.

Table 2–20 Estimated Non-CBM Employment Requirements for Alternative 1

Work Category	Time Requirements per Unit	Number of Units	Personnel Required (# per year)	Workdays for Project	Workdays per Year	Average # of Workers per Day
Construction and Installation						
Access Roads	1 day/mile	3,200	2	640	64	1
Well Pads	0.5 day/pad	3,200	1	160	16	1
Drilling and Casing	4 days/well	3,200	5	64,000	6,400	27
Well Completion	2 days/well	3,200	5	32,000	3,200	13
Total				96,800	9,680	42
Operation and Maintenance						
Road/Pad Maintenance	1 days/well	1,600	1	1,600	80	1
Pumpers	20 days/well	1,600	1	32,000	1,600	7
Office	2.5 days/well	1,600	2	8,000	400	2
Well Workover	4 days/well	1,600	5	32,000	1,600	7
Total			9	73,600	3,680	17
Decommissioning/Reclamation						
Wells	2 days/well	3,200	2	12,800	1,280	5
Roads	2 days/mile	3,200	1	6,400	640	3
Total			3	19,200	1,920	8

Well fires are very rare, but could occur under certain conditions. For the reasons listed in the previous sections, the probability of a blowout is very low. The Companies will include procedures for reporting and controlling fires in their emergency response programs. The Companies have and would continue to conduct cooperative training exercises with the fire and rescue departments within the Project Area.

Public Safety

The Companies would take measures to protect the public from hazards at well facilities. Warning signs would be placed around facilities, as necessary. Also, compressor stations would be fenced and gated.

Employee Safety

The Companies would develop Emergency Plans that would cover all potential emergencies, including fires, employee injuries, and chemical releases, among others. The Plans would include phone numbers for all medical and emergency services and the people to contact in event of emergencies. In addition, the Companies would not allow firearms to be brought into the area by employees and contractors. The Plans would be posted at all the Companies' local offices and field facilities. All employees and subcontractors would be trained on matters concerning the Emergency Plan when they are hired and refresher courses would be presented annually.

Water Monitoring and Mitigation

Monitoring and mitigation for both ground water and surface water are a substantial part of the Proposed Action. The Companies are conducting, and propose to continue to conduct, hydrologic monitoring to provide information to detect impacts on other water users and to control activities and operations to assure regulatory compliance and public protection.

Mitigation measures include the establishment of monitoring wells and stream gauges. The Companies work with the surface owners to establish water controls, diversions, and uses for the surface discharges. Treatment, injection, and storage may be used where necessary and practicable.

Ground Water

The Wyodak EIS established requirements for the Companies to drill and complete monitoring wells at specific locations throughout the Wyodak Area. The Companies propose to continue this program as part of the Proposed Action. The BLM is currently requiring monitoring well pairs (one in the coal and one in a sand over the coal) for the exploratory PODs well CMFs outside of the Wyodak EIS area. The purpose of these monitoring wells is to provide water level and pressure information to determine possible impacts to other water users.

All operators on federal minerals are required to offer a Water Well Agreement as set forth in the Gillette South EIS and the Wyodak EIS. This agreement protects nearby water wells permitted by the WSEO. The Companies generally offer the same agreement when drilling on fee and State lands.

Surface Water

The Companies are required to monitor and report produced water volumes and quality to WDEQ pursuant to NPDES permit requirements. Discharges are required to meet all applicable WDEQ water quality standards and regulations at all times. The Companies also must report produced water volumes to the WOGCC and WSEO.

The BLM water management plans, FS, and WDEQ require the Companies to use Best Management Practices (BMPs) that would prevent erosion and damage to agricultural activities.

Surface gauging stations may be needed on the Little Powder, Powder, Belle Fourche, Cheyenne, and Tongue Rivers. The cost of this monitoring would be shared among the BLM, the U.S. Department of Interior, Geological Survey (USGS), and the Companies.

The BLM would conduct periodic monitoring of water quality by sampling at discharge points and on streams. The BLM also would monitor selected stream channels receiving CBM discharged water for signs of accelerated erosion and degradation.

In August 2001, the States of Montana and Wyoming signed an Interim MOC to document their commitments and intent to protect and maintain water quality conditions in the PRB within Montana during an 18-month interim period (Appendix B). At the conclusion of this interim period, the states shall negotiate a final MOC that will include recognition of protective water quality standards and allocation of any assimilative capacity. A monitoring program to implement the interim MOC and to assist in the development of a final MOC is part of the agreement. Currently, the states are developing this monitoring program. Once developed, the aspects of the monitoring plan applicable to the oil and gas development addressed in this EIS would be incorporated into the ROD.

Alternative 2 — Proposed Action with Reduced Emission Levels and Expanded Produced Water Handling Scenarios

Alternative 2 was developed specifically to respond to four of the 18 key issues. They are the issues addressing effects of the Proposed Action on aquifers (Issue 1), the quantity and quality of surface waters (Issues 2 and 3), and effects on air quality and visibility (Issue 6). To respond to these issues, the BLM and FS altered the Proposed Action in two primary areas: the handling of produced water and compression of gas. Other than the differences described below, the rest of Alternative 2 is the same as the Proposed Action.

Methods for Handling Produced Water

The overall methods for handling the disposal of produced water are the same as those included in the Proposed Action. However, the BLM and FS have altered the distribution of produced water among the methods to emphasize handling in two ways. The two emphases are on infiltration and treatment. As shown on (Table 2–21), Alternative 2A emphasizes the use of infiltration impoundments to dispose of CMB produced water. In contrast, Alternative 2B emphasizes the use of passive and active treatment to dispose of CBM produced water (Table 2–22). The emphasis of these alternatives was developed in response to the WDEQ's projections for how CBM produced water probably would have to be handled in the future to meet the Montana–Wyoming Interim Water Quality Criteria MOC (Appendix B).

The changes in water handling methods included as part of Alternatives 2A and 2B slightly alter the number of acres that would be disturbed with their implementation. Instead of affecting 213,115 acres of short-term disturbance as Alternative 1 does, this Alternative 2A would affect 230,886 acres over the short term (Table 2–23). Long-term disturbance associated with Alternative 2A also would be slightly less at 127,693 acres (Table 2–24). In contrast, Alternative 2B would affect 222,860 acres over the short term (Table 2–25) and 119,667 acres over the long term (Table 2–26).

Compression

This alternative includes two options for compression of the CBM, both of which were analyzed in detail. The first option is the electrification of 50 percent of the booster compressors. Under this option, half of the new 1,060 booster compressor units would be electrically powered. The other half would be gas-fired units. The power for the electrical units would be brought to the compressor stations via the same power lines included in the Proposed Action. Thus, no new external construction would be required. Except for the exchange of gas-fired booster units for electrical booster units, no other visible changes would occur. Reciprocating compressors would remain the same.

Table 2–21 Assumed Water Handling Methods for CBM Wells with an Infiltration Emphasis — Alternative 2A

	Water Handling Method[1,2,3]						
	NPDES-permitted Discharge						
Sub-watershed	Untreated Discharge (percent)	Passive Treatment (percent)	Active Treatment (percent)	Infiltration Impoundment (percent)	Containment Impoundment (percent)	LAD (percent)	Injection (percent)
Upper Tongue River	5	5	0	60	10	10	10
Upper Powder River	5	20	0	55	5	10	5
Salt Creek	0	0	0	60	10	5	25
Crazy Woman Creek	5	5	0	60	10	10	10
Clear Creek	5	5	0	60	10	10	10
Middle Powder River	5	20	0	50	10	10	5
Little Powder River	5	20	0	50	10	10	5
Antelope Creek	0	40	0	40	5	10	5
Upper Cheyenne River	0	40	0	40	5	10	5
Upper Belle Fourche River	30	15	0	30	5	10	10

Notes:
1. The percentages shown represent the distribution of water handling methods assumed for the analysis, not the amount of water that actually reaches the river.
2. Handling Methods:
   - *NPDES-permitted Discharge* – includes methods of handling the produced water that require an NPDES permit.
   - *Untreated discharge* – water that is discharged onto the surface of the ground without any treatment.
   - *Passive treatment* – water that is amended through passive methods to meet standards before discharge. An example of this method is passing the water over scoria to remove iron.
   - *Active treatment* – water that is amended through active methods to meet standards before discharge. An example of this method is passing the water through a reverse osmosis system.
   - *Infiltration impoundment* – water contained in upland and bottomland impoundments designed for maximum infiltration and groundwater recharge.
   - *Containment impoundment* – includes upland impoundments, both lined and unlined, with minimal infiltration and no direct surface discharge or lateral subsurface movement of water and down-gradient expression in seeps or springs. These impoundments may be permitted by either the WOGCC or WDEQ.
   - *LAD* = land application. Typically, land application is achieved by spraying produced water through agricultural irrigation equipment and high-pressure atomizers.
   - *Injection* – represents that water that is injected into disposal wells.
3. The above percentages are not upper thresholds that can or will be enforced. They are merely a disclosure of effects of one of many various ways water may be handled to meet the Montana/Wyoming agreement of water quality levels at the state line.

The second option analyzed under this alternative was the electrification of all 1,060 new booster compressor units. Under this option, no new gas-fired boosters would be constructed. All would be electric. As noted above, no new external construction would be required and the reciprocating compressors would continue to be gas-fired units.

Under both of these options, new power generation capacity would be required to provide the electricity needed to power the electrical booster and reciprocating compressors. The potential locations and sizes of the facilities that could be constructed to provide the necessary additional capacity are too numerous and speculative to evaluate in this analysis.

Table 2–22 Assumed Water Handling Methods for CBM Wells with a Treatment Emphasis — Alternative 2B

	Water Handling Method[1,2,3]						
	NPDES-permitted Discharge						
Sub-watershed	Untreated Discharge (percent)	Passive Treatment (percent)	Active Treatment (percent)	Infiltration Impoundment (percent)	Containment Impoundment (percent)	LAD (percent)	Injection (percent)
Upper Tongue River	5	5	25	35	10	10	10
Upper Powder River	5	20	15	40	5	10	5
Salt Creek	0	0	0	60	10	5	25
Crazy Woman Creek	5	5	20	45	5	10	10
Clear Creek	5	5	20	45	5	10	10
Middle Powder River	5	20	20	30	10	10	5
Little Powder River	5	20	20	35	5	10	5
Antelope Creek	0	30	20	30	5	10	5
Upper Cheyenne River	0	30	20	30	5	10	5
Upper Belle Fourche River	30	20	0	25	5	10	10

Notes:
1. The percentages shown represent the distribution of water handling methods assumed for the analysis, not the amount of water that actually reaches the river.
2. Handling Methods:
   NPDES-permitted Discharge – includes methods of handling the produced water that require an NPDES permit.
   Untreated discharge – water that is discharged onto the surface of the ground without any treatment.
   Passive treatment – water that is amended through passive methods to meet standards before discharge. An example of this method is passing the water over scoria to remove iron.
   Active treatment – water that is amended through active methods to meet standards before discharge. An example of this method is passing the water through a reverse osmosis system.
   Infiltration impoundment – water contained in upland and bottomland impoundments designed for maximum infiltration and groundwater recharge.
   Containment impoundment – includes upland impoundments, both lined and unlined, with minimal infiltration and no direct surface discharge or lateral subsurface movement of water and down-gradient expression in seeps or springs. These impoundments may be permitted by either the WOGCC or WDEQ.
   LAD = land application. Typically, land application is achieved by spraying produced water through agricultural irrigation equipment and high-pressure atomizers.
   Injection – represents that water that is injected into disposal wells.
3. The above percentages are not upper thresholds that can or will be enforced. They are merely a disclosure of effects of one of many various ways water may be handled to meet the Montana/Wyoming agreement of water quality levels at the state line.

As a result of the changes in water handling for alternatives 2A and 2B relative to Alternative 1, additional numbers of employees would be needed to construct, operate, maintain, decommission, and reclaim the facilities. Table 2–27 and Table 2–28 summarize the estimated employment requirements for alternatives 2A and 2B.

Alternative 3 — No Action

The No Action alternative is required by NEPA for comparison to other alternatives analyzed in the EIS. For this analysis, the No Action alternative would not authorize additional natural gas development on Federal leases within the Project Area. Drilling could continue on State and private leases and access and pipelines across Federal lands to reach such proposed State and fee wells would be granted as required by the BLM's policy.

Table 2–23 Summary of Estimated Short-term CBM Disturbance Associated with Alternative 2A

			Roads		Poly Pipeline		Water Handling	Compressor Discharge Pipelines		Power Line	Compressor Stations		
Sub-watershed	Well Pads (acres)	CMFs (acres)	Improved (acres)	Two-track (acres)	2–3-inch (acres)	12-inch (acres)	Facilities[1] (acres)	Recip.[2] (acres)	Booster[3] (acres)	Overhead (acres)	Recip. (acres)	Booster (acres)	Total[4] (acres)
Little Bighorn River	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Tongue River	632	59	708	2,083	2,077	782	3,961	248	606	782	25	10	11,973
Middle Fork Powder River	0	0	0	0	0	0	0	0	0	0	0	0	0
North Fork Powder River	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Powder River	4,978	435	4,973	14,556	14,529	5,459	24,751	1,788	4,527	5,459	415	166	82,036
South Fork Powder River	0	0	0	0	0	0	0	0	0	0	0	0	0
Salt Creek	11	1	78	351	350	132	61	24	61	132	5	2	1,208
Crazy Woman Creek	774	67	1,030	3,299	3,289	1,235	4,468	291	1,014	1,235	50	20	16,772
Clear Creek	1,009	86	936	3,628	3,620	1,360	5,742	320	605	1,360	35	14	18,715
Middle Powder River	238	22	400	754	752	283	1,284	206	267	283	15	6	4,510
Little Powder River	534	47	818	4,230	4,222	1,586	2,727	218	323	1,586	20	8	16,319
Little Missouri River	0	0	0	0	0	0	0	0	0	0	0	0	0
Antelope Creek	474	38	2,076	14,732	14,695	5,524	1,825	127	298	5,524	25	10	45,348
Dry Fork Cheyenne River	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Cheyenne River	160	12	364	663	662	249	592	145	303	249	10	4	3,413
Lightning Creek	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Belle Fourche River	1,664	136	1,582	7,190	7,176	2,702	6,168	315	873	2,702	60	24	30,592
Middle North Platte River	0	0	0	0	0	0	0	0	0	0	0	0	0
Total[3]	10,474	903	12,965	51,486	51,372	19,312	51,579	3,682	8,877	19,312	660	264	230,886

Notes:

1. Disturbance includes the areal extent of direct discharge facilities, containment reservoirs, land application facilities, and injection wells. The ratios of water handling facilities applied to each sub-watershed are shown on Table 2–21.
2. Reciprocating (Recip.) compressors increase the compression of natural gas for delivery to high-compression transmission pipelines. Each station would consist of 1 to 6 recip compressors, depending upon the volume of gas being delivered to the station.
3. Booster compressors enhance the flow of gas from the wells to the recip compressors. Each station would consist of 1 to 6 booster compressors, depending upon the volume of gas being delivered to the station.
4. Total may not match precisely with the value obtained by adding unit numbers due to rounding conventions.

Source: BLM 2001e

Table 2–24 Summary of Estimated Long-term CBM Disturbance Associated with Alternative 2A

Sub-watershed	Well Pads (acres)	CMFs (acres)	Roads: Improved (acres)	Roads: Two-track (acres)	Poly Pipeline: 2–3-inch (acres)	Poly Pipeline: 12-inch (acres)	Water Handling Facilities[1] (acres)	Compressor Discharge Pipelines: Recip.[2] (acres)	Compressor Discharge Pipelines: Booster[3] (acres)	Power Line: Overhead (acres)	Compressor Stations: Recip. (acres)	Compressor Stations: Booster (acres)	Total[4] (acres)
Little Bighorn River	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Tongue River	259	24	708	2,083	0	0	3,961	0	0	261	25	10	7,331
Middle Fork Powder River	0	0	0	0	0	0	0	0	0	0	0	0	0
North Fork Powder River	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Powder River	1,897	174	4,973	14,556	0	0	24,751	0	0	1,820	415	166	48,752
South Fork Powder River	0	0	0	0	0	0	0	0	0	0	0	0	0
Salt Creek	4	0	78	351	0	0	61	0	0	44	5	2	545
Crazy Woman Creek	292	27	1,030	3,299	0	0	4,468	0	0	412	50	20	9,598
Clear Creek	375	35	936	3,628	0	0	5,742	0	0	453	35	14	11,218
Middle Powder River	96	9	400	754	0	0	1,284	0	0	94	15	6	2,658
Little Powder River	204	19	818	4,230	0	0	2,727	0	0	529	20	8	8,555
Little Missouri River	0	0	0	0	0	0	0	0	0	0	0	0	0
Antelope Creek	164	15	2,076	14,732	0	0	1,825	0	0	1,841	25	10	20,688
Dry Fork Cheyenne River	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Cheyenne River	54	5	364	663	0	0	592	0	0	83	10	4	1,775
Lightning Creek	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Belle Fourche River	593	55	1,582	7,190	0	0	6,168	0	0	901	60	24	16,573
Middle North Platte River	0	0	0	0	0	0	0	0	0	0	0	0	0
Total[3]	3,938	363	12,965	51,486	0	0	51,579	0	0	6,438	660	264	127,693

Notes:

1. Disturbance includes the areal extent of direct discharge facilities, containment reservoirs, land application facilities, and injection wells. The ratios of water handling facilities applied to each sub-watershed are shown on Table 2–21.
2. Reciprocating (Recip.) compressors increase the compression of natural gas for delivery to high-compression transmission pipelines. Each station would consist of 1 to 6 recip compressors, depending upon the volume of gas being delivered to the station.
3. Booster compressors enhance the flow of gas from the wells to the recip compressors. Each station would consist of 1 to 6 booster compressors, depending upon the volume of gas being delivered to the station.
4. Total may not match precisely with the value obtained by adding unit numbers due to rounding conventions

Source: BLM 2001e

Table 2–25 Summary of Estimated Short-term CBM Disturbance Associated with Alternative 2B

			Roads		Poly Pipeline		Water Handling	Compressor Discharge Pipelines		Power Line	Compressor Stations		
	Well Pads	CMFs	Improved	Two-track	2–3-inch	12-inch	Facilities[1]	Recip.[2]	Booster[3]	Overhead	Recip.	Booster	Total[4]
Sub-watershed	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)
Little Bighorn River	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Tongue River	632	59	708	2,083	2,077	782	3,120	248	606	782	25	10	11,132
Middle Fork Powder River	0	0	0	0	0	0	0	0	0	0	0	0	0
North Fork Powder River	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Powder River	4,978	435	4,973	14,556	14,529	5,459	21,053	1,788	4,527	5,459	415	166	78,338
South Fork Powder River	0	0	0	0	0	0	0	0	0	0	0	0	0
Salt Creek	11	1	78	351	350	132	61	24	61	132	5	2	1,208
Crazy Woman Creek	774	67	1,030	3,299	3,289	1,235	3,606	291	1,014	1,235	50	20	15,910
Clear Creek	1,009	86	936	3,628	3,620	1,360	4,635	320	605	1,360	35	14	17,608
Middle Powder River	238	22	400	754	752	283	1,035	206	267	283	15	6	4,261
Little Powder River	534	47	818	4,230	4,222	1,586	2,127	218	323	1,586	20	8	15,719
Little Missouri River	0	0	0	0	0	0	0	0	0	0	0	0	0
Antelope Creek	474	38	2,076	14,732	14,695	5,524	1,611	127	298	5,524	25	10	45,134
Dry Fork Cheyenne River	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Cheyenne River	160	12	364	663	662	249	522	145	303	249	10	4	3,343
Lightning Creek	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Belle Fourche River	1,664	136	1,582	7,190	7,176	2,702	5,783	315	873	2,702	60	24	30,207
Middle North Platte River	0	0	0	0	0	0	0	0	0	0	0	0	0
Total[3]	10,474	903	12,965	51,486	51,372	19,312	43,553	3,682	8,877	19,312	660	264	222,860

Notes:

1. Disturbance includes the areal extent of direct discharge facilities, containment reservoirs, land application facilities, and injection wells. The ratios of water handling facilities applied to each sub-watershed are shown on Table 2–22.
2. Reciprocating (Recip.) compressors increase the compression of natural gas for delivery to high-compression transmission pipelines. Each station would consist of 1 to 6 recip compressors, depending upon the volume of gas being delivered to the station.
3. Booster compressors enhance the flow of gas from the wells to the recip compressors. Each station would consist of 1 to 6 booster compressors, depending upon the volume of gas being delivered to the station.
4. Total may not match precisely with the value obtained by adding unit numbers due to rounding conventions.

Source: BLM 2001e

Table 2–26 Summary of Estimated Long-term CBM Disturbance Associated with Alternative 2B

			Roads		Poly Pipeline		Water Handling	Compressor Discharge Pipelines		Power Line	Compressor Stations		
Sub-watershed	Well Pads (acres)	CMFs (acres)	Improved (acres)	Two-track (acres)	2–3-inch (acres)	12-inch (acres)	Facilities[1] (acres)	Recip.[2] (acres)	Booster[3] (acres)	Overhead (acres)	Recip. (acres)	Booster (acres)	Total[4] (acres)
Little Bighorn River	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Tongue River	259	24	708	2,083	0	0	3,120	0	0	261	25	10	6,490
Middle Fork Powder River	0	0	0	0	0	0	0	0	0	0	0	0	0
North Fork Powder River	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Powder River	1,897	174	4,973	14,556	0	0	21,053	0	0	1,820	415	166	45,054
South Fork Powder River	0	0	0	0	0	0	0	0	0	0	0	0	0
Salt Creek	4	0	78	351	0	0	61	0	0	44	5	2	545
Crazy Woman Creek	292	27	1,030	3,299	0	0	3,606	0	0	412	50	20	8,736
Clear Creek	375	35	936	3,628	0	0	4,635	0	0	453	35	14	10,111
Middle Powder River	96	9	400	754	0	0	1,035	0	0	94	15	6	2,409
Little Powder River	204	19	818	4,230	0	0	2,127	0	0	529	20	8	7,955
Little Missouri River	0	0	0	0	0	0	0	0	0	0	0	0	0
Antelope Creek	164	15	2,076	14,732	0	0	1,611	0	0	1,841	25	10	20,474
Dry Fork Cheyenne River	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Cheyenne River	54	5	364	663	0	0	522	0	0	83	10	4	1,705
Lightning Creek	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Belle Fourche River	593	55	1,582	7,190	0	0	5,783	0	0	901	60	24	16,188
Middle North Platte River	0	0	0	0	0	0	0	0	0	0	0	0	0
Total[3]	3,938	363	12,965	51,486	0	0	43,553	0	0	6,438	660	264	119,667

Notes:

1. Disturbance includes the areal extent of direct discharge facilities, containment reservoirs, land application facilities, and injection wells. The ratios of water handling facilities applied to each sub-watershed are shown on Table 2–22.
2. Reciprocating (Recip.) compressors increase the compression of natural gas for delivery to high-compression transmission pipelines. Each station would consist of 1 to 6 recip compressors, depending upon the volume of gas being delivered to the station.
3. Booster compressors enhance the flow of gas from the wells to the recip compressors. Each station would consist of 1 to 6 booster compressors, depending upon the volume of gas being delivered to the station.
4. Total may not match precisely with the value obtained by adding unit numbers due to rounding conventions

Source: BLM 2001e

Table 2–27 Estimated CBM Employment Requirements for Alternative 2A

Work Category	Time Requirements per Unit	Number of Units	Personnel Required (# per year)	Workdays for Project	Workdays per Year	Average # of Workers per Day
Construction and Installation						
Access Roads	1 day/mile	17,276	2	34,552	3,455	14
Well Pads	0.5 day/pad	25,997	1	12,998	1,300	5
Pipelines	2 days/mile	20,474	3	94,164	9,416	39
Electrical Utility Lines	2 days/mile	5,311	5	53,110	5,311	22
Drilling and Casing	4 days/well	39,367	5	787,340	78,734	328
Well Completion	2 days/well	39,367	5	393,670	39,367	164
Compressor Facilities	21 days/compressor	970	28	570,360	57,036	238
Surface Discharge Fac.	5 days/pond	498	4	9,956	996	4
Infiltration Facilities	30 days/impound.	4,032	6	725,688	72,569	302
Containment Impound.	365 days/impound.	43	7	109,993	10,999	46
Injection well	6.5 days/well	342	6	13,333	1,333	6
Total			72	2,805,164	280,516	1,168
Operation and Maintenance						
Road/Pad Maintenance	1 days/well	39,367	1	39,367	1,968	8
Pumpers	20 days/well	39,367	1	787,374	39,367	164
Office	2.5 days/well	39,367	2	196,835	9,842	41
Well Workover	4 days/well	39,367	5	787,340	39,367	164
Surface Discharge Fac.	1 day/pond	498	1	498	25	0.1
Infiltration Facilities	1 day/facility	4,032	1	4,032	202	0.8
Containment Impound.	1 day/facility	43	1	43	4	0.0
Injection well	1 day/well	342	1	342	17	0.1
Total			13	1,815,831	90,792	378
Decommissioning/Reclamation						
Wells	2 days/well	39,367	2	157,468	15,747	66
Roads	2 days/mile	17,276	1	34,552	3,455	14
Compressor Stations	100 days/compressor	970	10	970,000	97,000	404
Reclamation	5 days/facility	313	3	4,695	470	2
Surface Discharge Fac.	2 days/pond	498	3	2,987	299	1
Infiltration Facilities	10 days/facility	4,032	13	524,108	52,411	218
Containment Impound.	60 days/facility	43	7	18,081	1,808	8
Injection well	2 days/well	342	2	1,368	137	1
Total			41	1,713,259	171,327	714

The Department of Interior's authority to implement a "No Action" alternative that precludes development by denying the process is, however, limited. An oil and gas lease grants the lessee the "right and privilege to drill for, mine, extract, remove, and dispose of all oil and gas deposits" in the lease lands, "subject to the terms and conditions incorporated in the lease (Form 3110–2). Because the Secretary of Interior has the authority and responsibility to protect the environment within Federal oil and gas leases, restrictions are imposed on the lease terms.

Table 2–28 Estimated CBM Employment Requirements for Alternative 2B

Work Category	Time Requirements per Unit	Number of Units	Personnel Required (# per year)	Workdays for Project	Workdays per Year	Average # of Workers per Day
Construction and Installation						
Access Roads	1 day/mile	17,276	2	34,552	3,455	14
Well Pads	0.5 day/pad	25,997	1	12,998	1,300	5
Pipelines	2 days/mile	20,474	3	94,164	9,416	39
Electrical Utility Lines	2 days/mile	5,311	5	53,110	5,311	22
Drilling and Casing	4 days/well	39,367	5	787,340	78,734	328
Well Completion	2 days/well	39,367	5	393,670	39,367	164
Compressor Facilities	21 days/compressor	970	28	570,360	57,036	238
Surface Discharge Fac.	5 days/pond	795	4	15,896	1,590	7
Infiltration Facilities	30 days/impound.	2,931	6	527,544	52,754	220
Containment Impound.	365 days/impound.	36	7	91,469	9,147	38
Injection well	6.5 days/well	342	6	13,333	1,333	6
Total			72	2,594,436	259,443	1,081
Operation and Maintenance						
Road/Pad Maintenance	1 days/well	39,367	1	39,367	1,968	8
Pumpers	20 days/well	39,367	1	787,374	39,367	164
Office	2.5 days/well	39,367	2	196,835	9,842	41
Well Workover	4 days/well	39,367	5	787,340	39,367	164
Surface Discharge Fac.	1 day/pond	795	1	795	40	0.2
Infiltration Facilities	1 day/facility	2,931	1	2,931	147	0.6
Containment Impound.	1 day/facility	36	1	36	4	0.0
Injection well	1 day/well	342	1	342	17	0.1
Total			13	1,815,020	90,752	378
Decommissioning/Reclamation						
Wells	2 days/well	39,367	2	157,468	15,747	66
Roads	2 days/mile	17,276	1	34,552	3,455	14
Compressor Stations	100 days/compressor	970	10	970,000	97,000	404
Reclamation	5 days/facility	313	3	4,695	470	2
Surface Discharge Fac.	2 days/pond	795	3	4,769	477	2
Infiltration Facilities	10 days/facility	2,931	13	381,004	38,100	159
Containment Impound.	60 days/facility	36	7	15,036	1,504	6
Injection well	2 days/well	342	2	1,368	137	1
Total			41	1,568,892	156,890	654

On land leased without a No Surface Occupancy or similarly restrictive lease stipulation, the Department of Interior cannot deny a permit to drill. Once the land is leased, the Department no longer has the authority to preclude surface-disturbing activity, even if the environmental impact of such activity is significant. The Department can only impose mitigation measures upon a lessee who pursues surface-disturbing activities. By issuing a lease, the Department has made an irrevocable commitment to allow some surface disturbances (Tenth Circuit Court of Appeals in Sierra Club vs. Peterson [717 F. 2d 1409, 1983]).

Leases within the Project Area contain various stipulations concerning surface disturbance, surface occupancy, limited surface area, and timing restrictions. In addition, the lease stipulations provide for the imposition of such reasonable conditions, not inconsistent with the purposes for which the lease was issued, as the (BLM and/or FS) may require to protect the surface of the leased lands and the environment. None of the stipulations, however, would empower the Secretary of Interior to deny all development activity because of environmental concerns. Provisions in leases that expressly provide authority to deny or restrict development in whole or in part depend upon conformance with certain non-discretionary statutes, such as the ESA (43 CFR 3101.1–2).

Coal Bed Methane Development

Under this alternative, development of non-federal CBM would continue to occur on non-federal lands. The agencies assumed development of fee and state minerals would occur along the same overall schedule as for Alternative 1.

As a result, the Companies would drill 15,458 new CBM wells between 2002 and 2011 (Table 2–29). These wells would be in addition to the 12,077 CBM wells already permitted or drilled on federal, state, and private lands. Thus, 27,535 CBM wells would be developed under this alternative by 2011 (Table 2–29).

Table 2–29 Distribution of CBM Wells by Sub-watershed — Alternative 3

	Number of CBM Wells		
Sub-watershed	Pre 2002	2002–2011	Total
Little Bighorn River	0	0	0
Upper Tongue River	815	2,158	2,973
Middle Fork Powder River	0	0	0
North Fork Powder River	0	0	0
Upper Powder River	2,808	4,436	7,244
South Fork Powder River	0	0	0
Salt Creek	0	19	19
Crazy Woman Creek	150	934	1,084
Clear Creek	389	2,488	2,877
Middle Powder River	727	201	928
Little Powder River	1,813	959	2,772
Little Missouri River	0	0	0
Antelope Creek	253	603	856
Dry Fork Cheyenne River	0	0	0
Upper Cheyenne River	454	260	714
Lightning Creek	0	0	0
Upper Belle Fourche River	4,662	3,400	8,062
Middle North Platte River	6	0	6
Total	12,077	15,458	27,535

Source: BLM 2001

As under alternatives 1 and 2, some of the new CBM wells would be drilled from the same well pads. Thus, the number of pads constructed would be less than the number of wells drilled. The Companies would construct a total of 10,534 new well pads between 2002 and 2011 (Table 2–30). With the 9,592 pads constructed or permitted for construction before 2002, this alternative would result in a total of 20,126 well pads by 2011 (Table 2–30).

Table 2–30 Distribution of CBM Well Pads by Sub-watershed — Alternative 3

	Number of CBM Well Pads		
Sub-watershed	Pre 2002	2002–2011	Total
Little Bighorn River	0	0	0
Upper Tongue River	396	974	1,370
Middle Fork Powder River	0	0	0
North Fork Powder River	0	0	0
Upper Powder River	2,253	2,839	5,092
South Fork Powder River	0	0	0
Salt Creek	0	11	11
Crazy Woman Creek	63	629	692
Clear Creek	229	1,739	1,968
Middle Powder River	434	97	531
Little Powder River	1,301	652	1,953
Little Missouri River	0	0	0
Antelope Creek	251	526	777
Dry Fork Cheyenne River	0	0	0
Upper Cheyenne River	389	260	649
Lightning Creek	0	0	0
Upper Belle Fourche River	4,270	2,807	7,077
Middle North Platte River	6	0	6
Total	9,592	10,534	20,126

Source: BLM 2001

Because fewer new wells would be drilled and pads constructed, the number of facilities constructed also would be smaller than under the Proposed Action (Table 2–31). Furthermore, the overall short-term and long-term disturbances associated with this alternative would be less than that which would occur with implementation of Alternative 1 or Alternative 2 (Table 2–32 and Table 2–33).

With fewer wells overall, implementation of this alternative also would result in smaller amounts of produced water and gas. Table 2–34 and Table 2–35 show the amounts of water and gas projected for this alternative, respectively.

Table 2–31 Summary of New Facilities Comprising Alternative 3

		Roads		Poly Pipeline		Steel Pipeline	Electrical Line	Recip Compressors[1]		Booster Compressors[2]	
Sub-watershed	Well[3] Pads	Improved (miles)	Two-track (miles)	2–3-inch (miles)	12-inch (miles)	12-inch (miles)	Overhead (miles)	(units)	(horsepower)	(units)	(horsepower)
Little Bighorn River	0	0	0	0	0	0	0	0	0	0	0
Upper Tongue River	974	184	367	488	184	60	184	7	11,550	25	8,750
Middle Fork Powder River	0	0	0	0	0	0	0	0	0	0	0
North Fork Powder River	0	0	0	0	0	0	0	0	0	0	0
Upper Powder River	2,839	360	720	958	360	125	360	44	72,600	161	56,350
South Fork Powder River	0	0	0	0	0	0	0	0	0	0	0
Salt Creek	11	0	0	0	0	4	0	1	1,650	2	700
Crazy Woman Creek	629	113	226	300	113	36	113	7	11,550	23	8,050
Clear Creek	1,739	252	504	670	252	51	252	9	14,850	32	11,200
Middle Powder River	97	16	32	43	16	8	16	0	0	2	700
Little Powder River	652	225	450	598	225	23	225	4	6,600	14	4,900
Little Missouri River	0	0	0	0	0	0	0	0	0	0	0
Antelope Creek	526	551	1,101	1,465	551	13	551	4	6,600	15	5,250
Dry Fork Cheyenne River	0	0	0	0	0	0	0	0	0	0	0
Upper Cheyenne River	260	33	67	89	33	18	33	2	3,300	8	2,800
Lightning Creek	0	0	0	0	0	0	0	0	0	0	0
Upper Belle Fourche River	2,807	436	870	1,158	436	58	436	19	31,350	68	23,800
Middle North Platte River	0	0	0	0	0	0	0	0	0	0	0
Total	10,534	2,170	4,337	5,769	2,170	396	2,170	97	160,050	350	122,500

Notes:

1. Reciprocating (Recip.) compressors increase the compression of natural gas for delivery to high-compression transmission pipelines. Each station would consist of 1 to 6 recip compressors, depending upon the volume of gas being delivered to the station.
2. Booster compressors enhance the flow of gas from the wells to the recip compressors. Each station would consist of 1 to 6 booster compressors, depending upon the volume of gas being delivered to the station.
3. Total may not match precisely with the value obtained by adding unit numbers due to rounding conventions.

Source: BLM 2001e

Table 2–32 Summary of Estimated Short-term Disturbance Associated with Alternative 3

			Roads		Poly Pipeline		Water Handling	Compressor Discharge Pipelines		Power Line	Compressor Stations		
Sub-watershed	Well Pads (acres)	CMFs (acres)	Improved (acres)	Two-track (acres)	2–3-inch (acres)	12-inch (acres)	Facilities[1] (acres)	Recip.[2] (acres)	Booster[3] (acres)	Overhead (acres)	Recip. (acres)	Booster (acres)	Total[4] (acres)
Little Bighorn River	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Tongue River	632	50	223	1,781	1,776	669	2,600	212	518	669	10	8	9,148
Middle Fork Powder River	0	0	0	0	0	0	0	0	0	0	0	0	0
North Fork Powder River	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Powder River	4,978	102	436	3,490	3,483	1,309	2,906	429	1,085	1,309	30	38	19,595
South Fork Powder River	0	0	0	0	0	0	0	0	0	0	0	0	0
Salt Creek	11	0	13	104	20	39	17	12	31	39	5	2	293
Crazy Woman Creek	774	22	136	1,093	1,090	409	672	96	336	409	5	6	5,048
Clear Creek	1,009	57	305	2,441	2,436	916	2,911	215	407	916	10	10	11,633
Middle Powder River	238	5	20	157	157	59	165	43	56	59	0	2	961
Little Powder River	534	22	273	2,180	2,176	818	786	112	166	818	5	4	7,894
Little Missouri River	0	0	0	0	0	0	0	0	0	0	0	0	0
Antelope Creek	474	14	668	5,340	5,328	2,003	552	46	108	2,003	5	4	16,545
Dry Fork Cheyenne River	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Cheyenne River	160	6	41	324	323	122	238	71	148	122	0	2	1,557
Lightning Creek	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Belle Fourche River	1,665	78	529	4,220	4,211	1,586	3,537	185	512	1,586	10	14	18,133
Middle North Platte River	0	0	0	0	0	0	0	0	0	0	0	0	0
Total[3]	10,475	356	2,644	21,130	21,000	7,930	14,384	1,421	3,367	7,930	80	90	90,807

Notes:

1. Disturbance includes the areal extent of direct discharge facilities, containment reservoirs, land application facilities, and injection wells. The ratios of water handling facilities applied to each sub-watershed are shown on Table 2–9.
2. Reciprocating (Recip.) compressors increase the compression of natural gas for delivery to high-compression transmission pipelines. Each station would consist of 1 to 6 recip compressors, depending upon the volume of gas being delivered to the station.
3. Booster compressors enhance the flow of gas from the wells to the recip compressors. Each station would consist of 1 to 6 booster compressors, depending upon the volume of gas being delivered to the station.
4. Total may not match precisely with the value obtained by adding unit numbers due to rounding conventions.

Source: BLM 2001e

Table 2–33 Summary of Estimated Long-term Disturbance Associated with Alternative 3

			Roads		Poly Pipeline		Water Handling	Compressor Discharge Pipelines		Power Line	Compressor Stations		
	Well Pads	CMFs	Improved	Two-track	2–3-inch	12-inch	Facilities[1]	Recip.[2]	Booster[3]	Overhead	Recip.	Booster	Total[4]
Sub-watershed	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)
Little Bighorn River	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Tongue River	259	20	223	1,781	0	0	2,600	0	0	223	10	8	5,124
Middle Fork Powder River	0	0	0	0	0	0	0	0	0	0	0	0	0
North Fork Powder River	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Powder River	1,897	41	436	3,490	0	0	2,906	0	0	437	30	38	9,275
South Fork Powder River	0	0	0	0	0	0	0	0	0	0	0	0	0
Salt Creek	4	0	13	104	0	0	17	0	0	13	5	2	158
Crazy Woman Creek	292	9	136	1,093	0	0	672	0	0	137	5	6	2,350
Clear Creek	375	23	305	2,441	0	0	2,911	0	0	306	10	10	6,381
Middle Powder River	96	2	20	157	0	0	165	0	0	20	0	2	462
Little Powder River	204	9	273	2,180	0	0	786	0	0	273	5	4	3,734
Little Missouri River	0	0	0	0	0	0	0	0	0	0	0	0	0
Antelope Creek	164	6	668	5,340	0	0	552	0	0	669	5	4	7,408
Dry Fork Cheyenne River	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Cheyenne River	54	2	41	324	0	0	238	0	0	41	0	2	702
Lightning Creek	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Belle Fourche River	593	31	529	4,220	0	0	3,537	0	0	529	10	14	9,463
Middle North Platte River	0	0	0	0	0	0	0	0	0	0	0	0	0
Total[3]	3,938	143	2,644	21,130	0	0	14,384	0	0	2,648	80	90	45,057

Notes:

1. Disturbance includes the areal extent of direct discharge facilities, containment reservoirs, land application facilities, and injection wells. The ratios of water handling facilities applied to each sub-watershed are shown on Table 2–9.
2. Reciprocating (Recip.) compressors increase the compression of natural gas for delivery to high-compression transmission pipelines. Each station would consist of 1 to 6 recip compressors, depending upon the volume of gas being delivered to the station.
3. Booster compressors enhance the flow of gas from the wells to the recip compressors. Each station would consist of 1 to 6 booster compressors, depending upon the volume of gas being delivered to the station.
4. Total may not match precisely with the value obtained by adding unit numbers due to rounding conventions.

Source: BLM 2001e

Table 2–34 Projected Amount of Water Produced from CBM Wells Under Alternative 3

	Water Produced (acre-feet)[1]																
Sub-watershed	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
Little Bighorn River	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Tongue River	14,207	20,707	25,788	27,619	28,922	29,016	28,324	28,804	27,525	27,461	18,794	11,629	6,029	2,476	1,046	361	298,708
Middle Fork Powder River	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
North Fork Powder River	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Powder River	68,362	79,569	84,454	81,929	75,264	78,385	67,532	50,015	34,029	22,484	12,551	6,812	3,029	1,062	437	153	666,067
South Fork Powder River	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Salt Creek	158	135	135	200	293	229	163	93	56	27	10	0	0	0	0	0	1,499
Crazy Woman Creek	7,315	10,975	14,030	15,954	16,079	15,934	14,947	12,216	11,233	10,487	7,166	4,484	2,312	970	338	111	144,551
Clear Creek	15,151	26,246	35,117	38,360	39,582	39,564	39,230	36,008	34,535	34,411	23,950	15,177	7,856	3,364	1,136	392	390,079
Middle Powder River	10,444	8,165	6,259	4,436	2,900	2,388	1,950	2,091	1,576	1,502	984	654	348	184	68	32	43,981
Little Powder River	19,531	16,128	12,201	9,825	8,581	6,814	6,163	5,349	5,578	4,875	3,288	1,882	983	448	256	92	101,994
Little Missouri River	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Antelope Creek	4,695	5,067	5,059	4,919	4,700	4,845	4,527	3,693	2,757	2,043	1,266	772	379	161	84	29	44,996
Dry Fork Cheyenne River	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Cheyenne River	6,957	6,185	5,219	4,191	3,198	2,958	2,560	2,009	1,697	1,212	778	430	226	95	40	8	37,763
Lightning Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Belle Fourche River	59,592	51,467	43,558	35,112	30,988	29,491	25,519	19,461	13,975	10,057	6,081	3,556	1,732	653	300	164	331,706
Middle North Platte River	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	206,412	224,644	231,820	222,545	210,507	209,624	190,915	159,739	132,961	114,559	74,868	45,396	22,894	9,413	3,705	1,342	2,061,344

Note:

1. Volumes shown include produced water from pre-2002 wells as well as the new CBM wells.

Source: BLM 2001e

Table 2–35 Projected Amounts of Natural Gas Produced from CBM Wells Under Alternative 3

	Total Cubic Feet of Methane Produced per Day by Year (in mmcf)									
Sub-watershed	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Little Bighorn River	0	0	0	0	0	0	0	0	0	0
Upper Tongue River	18	30	47	60	70	74	76	77	77	77
Middle Fork Powder River	0	0	0	0	0	0	0	0	0	0
North Fork Powder River	0	0	0	0	0	0	0	0	0	0
Upper Powder River	252	399	481	534	542	538	520	446	308	192
South Fork Powder River	0	0	0	0	0	0	0	0	0	0
Salt Creek	4	6	7	8	8	7	7	6	4	2
Crazy Woman Creek	31	50	63	72	75	75	74	66	51	38
Clear Creek	37	58	76	89	97	101	103	102	97	93
Middle Powder River	2	3	4	5	5	6	6	6	6	6
Little Powder River	26	39	45	49	50	50	51	49	43	38
Little Missouri River	0	0	0	0	0	0	0	0	0	0
Antelope Creek	29	44	50	54	54	53	52	45	33	23
Dry Fork Cheyenne River	0	0	0	0	0	0	0	0	0	0
Upper Cheyenne River	15	22	25	27	27	27	27	27	23	20
Lightning Creek	0	0	0	0	0	0	0	0	0	0
Upper Belle Fourche River	161	228	252	264	261	260	257	233	180	132
Middle North Platte River	0	0	0	0	0	0	0	0	0	0
Total	575	879	1,050	1,162	1,189	1,191	1,173	1,057	822	621

Source: BLM 2001e

Drilling and Construction of Facilities

Electrical Power Utilities

Based on projected power demands, it is anticipated that the Companies would require 0.5 MW per day to transport 3 bcf of natural gas per day using gas-fired compression. Based on this power demand, the maximum power requirement would be 0.6 MW per day.

Under this alternative, three-phase 24.9-kV distribution lines would connect wells and compressor facilities with the existing transmission and distribution system within the Project Area. Electricity would be routed to compressor stations and CMFs aboveground on poles generally located along the access roads or on additional rights-of-way (30 feet wide) across open land. Between the CMFs and wells, the secondary electric service power lines (480 volt) would be buried in the same trenches with the gas- and produced water-gathering pipelines. The installation and power would be provided by the utility company providing these services. Construction of the power lines would follow access road development and coincide with the completion of well drilling. The power lines would be designed and constructed according to the Avian Power Line Interaction Committee's (1996) guidelines for the prevention of electrocution of raptors.

The aboveground power lines would be constructed using tracked and wheeled equipment. Holes for the poles would be located to not disturb existing sensitive vegetation and would be excavated to a depth of 6 to 8 feet. Poles and other structural components would be transported to the construction site where they would be assembled and then erected by a boom truck.

Pole locations could be moved within the 30-foot wide ROW if topography and/or impacts to cultural, vegetative, or wildlife resources are identified at the site of the structure. In areas of thick vegetation and/or where vegetation may impede the performance of the active line, vegetation would be cleared, typically with hand-held equipment. Where areas of sensitive plant resources are known to occur, the BLM would be consulted before removal of any vegetation.

All aboveground electric lines typically would be installed on 35-foot tall poles. Poles would be required approximately every 300 feet. Approximately 2,170 miles of aboveground power lines would be installed in the Project Area (Table 2–31). The short-term disturbance for these lines would be 7,930 acres (Table 2–32).

Workforce Requirements

Most of the active workforce involved in developing Alternative 3 would be involved in construction-related activities. After roads and well pads are constructed, pipelines and utility lines are installed, and wells are drilled and completed, minimal personnel would be required to operate the field. Table 2–36 shows the estimated employment requirements for the construction, operation, and reclamation of the project under Alternative 3.

Table 2–36 Estimated CBM Employment Requirements for Alternative 3

Work Category	Time Requirements per Unit	Number of Units	Personnel Required (# per task)	Workdays for Project	Workdays per Year	Average # of Workers per Day
Construction and Installation						
Access Roads	1 day/mile	6,507	2	13,014	1,301	5
Well Pads	0.5 day/pad	10,534	1	5,267	527	2
Pipelines	2 days/mile	8,335	3	50,010	5,001	21
Electrical Utility Lines	2 days/mile	2,170	5	21,700	2,170	9
Drilling and Casing	4 days/well	15,458	5	309,160	30,916	129
Well Completion	2 days/well	15,458	5	154,580	15,458	64
Compressor Facilities	21 days/compressor	60	28	35,280	3,528	15
Surface Discharge Fac.	5 days/pond	419	4	8,376	838	3
Infiltration Facilities	30 days/facility	893	6	160,668	16,067	67
Containment Impound.	365 days/impound.	16	7	39,986	3,999	17
Injection well	6.5 days/well	147	6	5,728	573	2
Total				803,769	80,378	334
Operation and Maintenance						
Road/Pad Maintenance	1 days/well	15,458	1	15,458	773	3
Pumpers	20 days/well	15,458	1	309,160	15,458	64
Office	2.5 days/well	15,458	2	69,561	3,478	14
Well Workover	4 days/well	15,458	5	309,160	15,458	64
Surface Discharge Fac.	1 day/pond	419	1	419	21	0.1
Infiltration Facilities	1 day/facility	893	1	893	45	0.2
Containment Impound.	1 day/impound.	16	1	16	2	0.0
Injection well	1 day/well	147	1	147	7	0.0
Total			13	704,814	35,242	145
Decommissioning/Reclamation						
Wells	2 days/well	15,458	2	61,832	6,183	26
Roads	2 days/mile	6,507	1	13,014	1,301	5
Compressor Stations	100 days/compressor	60	10	60,000	6,000	25
Reclamation	5 days/facility	127	3	145,161	14,516	60
Surface Discharge Fac.	2 days/pond	419	3	2,513	251	1
Infiltration Facilities	10 days/facility	893	13	116,038	251	1
Containment Impound.	60 days/impound.	16	7	6,573	657	3
Injection well	2 days/well	147	2	588	59	0
Total			41	405,719	29,218	121

Construction Resource Requirements

Construction of the project would require a variety of materials and equipment. The primary materials would be water, sand, and gravel. Additionally, small amounts of chemicals would be required. Equipment needed for construction would include heavy equipment (bulldozers, graders, track hoes, trenchers, and front-end loaders) and heavy- and light-duty trucks.

Water would be needed for constructing roads, pipelines, and compressor stations. It also would be needed for drilling wells. Overall, the requirement for water to construct Alternative 3 is expected to be about 6,896 acre-feet (Table 2–37). This water would be obtained from local sources.

Table 2–37 Summary of Sand, Gravel, and Water Requirements for Alternative 3

Facility	Amount	Unit	Rate	Total Volume
Sand and Gravel				
Improved roads	6,657	miles	1,173 yd^3/mile	7,808,661
CMFs	1,546	CMFs	30 yd^3/CMF	46,380
Compressors		stations	1,100 yd3/station	344,300
Total (yd^3)				8,199,341
Water				
Roads	6,507	miles	0.1 acre-feet/mile	651
Pipelines	7,939	miles	0.04 acre-feet/mile	317
Well drilling	15,458	wells	0.08 acre-feet/well	1,237
Well completion	15,458	wells	0.05 acre-feet/well	773
Compressors		Compressor	0.01 acre-feet/compressor	10
Total (acre-feet)				2,988

Non-CBM Development

As with the CBM wells, development of non-federal CBM would continue to occur on non-federal lands. The agencies assumed development would be proportional to the areal extent of private and state minerals present in the Project Area. Table 2–38 shows the projected distribution of non-CBM wells for Alternative 3.

Surface disturbance for a typical non-CBM well includes 2 acres for the well pad and 1.5 acres for a 1 mile bladed road for a total of 3.5 acres disturbed for drilling operations. Surface disturbance for a typical deep oil well (from 5,000 to 12,000 feet deep) includes 4 acres for the well pad and 1.5 acres for a 1 mile bladed road for a total of 5.5 acres disturbed for drilling operations. Part of the well pad area is reclaimed for production operations, and the entire area of disturbance is reclaimed when the well is plugged and abandoned.

As shown on Table 2–39, almost 17,600 surface acres of the Project Area may be disturbed by the construction of non-CBM wells. Most of this disturbance would occur in three watersheds. They are Little Powder River, Upper Belle Fourche River, and Upper Powder River. Once the wells are operational and partial reclamation has occurred, long-term disturbance would encompass about 82 percent of the original disturbance.

The non-CBM development also would require a workforce involved in construction-related activities. After roads and well pads are constructed and wells are drilled and completed, minimal personnel would be required to operate the field. Table 2–40 shows the estimated employment requirements for the non-CBM wells.

Table 2–38 Projected Distribution of Non-CBM Wells Under Alternative 3

Sub-watershed	Potential for Oil and Gas: Very Low	Low	Moderate	High	Total
Buffalo Field Office Area					
Little Bighorn River	1	0	0	0	1
Upper Tongue River	3	12	0	0	15
Middle Fork Powder River	9	1	0	0	10
North Fork Powder River	1	0	0	0	1
Upper Powder River	0	11	165	0	176
South Fork Powder River	1	1	0	0	2
Salt Creek	0	1	9	0	10
Crazy Woman Creek	1	8	2	0	11
Clear Creek	1	11	0	0	12
Middle Powder River	0	1	25	18	44
Little Powder River	0	0	71	598	669
Little Missouri River	0	0	2	41	43
Antelope Creek	0	1	36	0	37
Upper Cheyenne River	0	2	15	0	17
Upper Belle Fourche River	0	2	95	176	273
Total	17	51	420	833	1,321
Casper Field Office Area					
Converse County					88
Total					1,409

Alternatives Considered but Eliminated from Detailed Analysis

Several potential alternatives were considered for this analysis, but were dropped from detailed study for various reasons. These alternatives are listed below and the reasons they were excluded from further consideration are described.

Alternative Considered: Return all produced water to aquifers

Reasons Considered: This alternative was specifically developed to respond to issues about effects to aquifers and soils and the quantity and quality of surface water in and downstream of the Project Area. Under this alternative, the Companies would capture and actively return produced water to aquifers. Methods for accomplishing this return include storage and retrieval wells, infiltration pits, land application (e.g., spreaders and sprinklers), infiltration at clinker zones, and leach fields.

Table 2–39 Projected Maximum Disturbance Due to Non-CBM Wells Under Alternative 3

Sub-watershed	Areal Extent of Disturbance Short-term (acres)	Areal Extent of Disturbance Long-term (acres)
Buffalo Field Office Area and TBNG		
Little Bighorn River	6	4
Upper Tongue River	82	68
Middle Fork Powder River	55	45
North Fork Powder River	6	4
Upper Powder River	968	792
South Fork Powder River	11	9
Salt Creek	55	45
Crazy Woman Creek	60	50
Clear Creek	66	54
Middle Powder River	242	198
Little Powder River	3,680	3,010
Little Missouri River	236	194
Antelope Creek	204	166
Upper Cheyenne River	94	76
Upper Belle Fourche River	1,502	1,228
Total	7,267	5,943
Casper Field Office Area		
Converse County	484	396
Total	7,751	6,339

Note:
Maximum disturbance is based on 5.5 acres and 4.5 acres per well for short-term and long-term disturbances, respectively.

Table 2–40 Estimated Non-CBM Employment Requirements for Alternative 3

Work Category	Time Requirements per Unit	Number of Units	Personnel Required (# per year)	Workdays for Project	Workdays per Year	Average # of Workers per Day
Construction and Installation						
Access Roads	1 day/mile	1,345	2	2,690	269	1
Well Pads	0.5 day/pad	1,345	1	672	67	1
Drilling and Casing	4 days/well	1,345	5	26,900	2,690	11
Well Completion	2 days/well	1,345	5	13,450	1,345	6
Total				43,712	4,371	19
Operation and Maintenance						
Road/Pad Maintenance	1 days/well	673	1	673	34	1
Pumpers	20 days/well	673	1	13,460	673	3
Office	2.5 days/well	673	2	1,682	84	1
Well Workover	4 days/well	673	5	13,460	673	3
Total			9	29,275	1,464	8
Decommissioning/Reclamation						
Wells	2 days/well	1,345	2	5,380	538	2
Roads	2 days/mile	1,345	1	2,690	269	1
Total			3	8,070	807	3

Reasons Dropped:	The feasibility of an all re-injection alternative appears to be limited. The BLM and FS could not require the Companies to implement this alternative. Much of the Project Area involves non-federal minerals and non-federal surface over which the BLM and FS have no jurisdiction. Thus, they could not legally require the Companies to return produced water to aquifers where the agencies do not have the legal authority. Furthermore, the alternatives considered in detail involve returning at least a portion of the produced water to aquifers.

Alternative Considered:	Capture and treat produced water for additional beneficial uses.
Reasons Considered:	Under this alternative, the Companies would capture the produced water, treat it, and make it available for additional beneficial uses. These uses include stock watering, wildlife habitat (aquatic, wetlands, and riparian), recreational opportunities (e.g., hunting of waterfowl), and irrigation. In addition to responding to the issues about effects to aquifers and soils and the quantity and quality of surface water in and downstream of the Project Area, this alternative was developed to respond to effects on terrestrial and aquatic wildlife and recreational opportunities.
Reasons Dropped:	This alternative technically would not be feasible over the long term. Each CBM well is expected to produce water for a maximum of seven years with a peak in production occurring during the initial few years. If the agencies required the Companies to treat the produced water and make it available to additional beneficial uses, these uses essentially would be relatively short term in nature. Once the produced water from specific wells diminishes, the beneficial uses supported by that water also would diminish. Thus, beneficial uses also would be short term in nature wherever they would occur.

Alternative Considered:	Staged rate of development.
Reasons Considered:	This alternative was developed in response to a variety of the issues raised during scoping, including concerns about the volume of water discharged to local drainages. Under this alternative, the Companies would control the number of rigs operating in the Project Area and would

develop their leases in stages. The number of rigs working in the Project Area would be less than the number currently working in the area.

Reasons Dropped: The BLM and FS have no legal authority to control how the Companies develop their leases, as long as they meet the Conditions of Approval and requirements of all their other permits. Furthermore, much of the minerals and surface in the Project Area are owned by the State of Wyoming or private parties. The BLM and FS have no legal authority to direct the Companies how they should develop these leases. Additionally, the BLM and FS have a legal obligation to ensure that leased federal minerals are fully developed and that federal minerals are not drained by production occurring on non-federal leases.

Alternative Considered: No action on all lands.

Reasons Considered: This alternative was considered as a true No Action alternative under NEPA. Under this alternative, no further drilling or development of oil or gas wells would occur anywhere within the Project Area.

Reasons Dropped: This alternative was dropped from detailed consideration because it was not at all feasible. Development of fee and state minerals, particularly those already leased, would continue regardless of the BLM and FS' decisions. Because the development of fee and state minerals undoubtedly will occur, the BLM and FS decided a No Action alternative that involved development of fee and state minerals without the development of federal minerals would more closely resemble the actual situation of the BLM and FS denying any further development of CBM from federal minerals.

Alternative Considered: Surface discharge produced water, but ensure water quality at the Wyoming–Montana border does not change enough to adversely affect the uses of water at and downstream of the Wyoming–Montana border.

Reasons Considered: This alternative was considered as a means to address the State of Montana's concerns about the quality of surface water entering the State. Under this alternative, the quality and quantity of discharges of produced water would be monitored to ensure any changes in water quality at the Montana-Wyoming State Line would be insufficient to affect downstream uses of that water in Montana.

Reasons Dropped: The signing and implementation of the Montana and Wyoming Powder River Interim Water Quality Criteria Memorandum of Cooperation essentially eliminated this alternative. If the water monitoring conducted under this agreement suggests produced water discharging into the rivers and subsequently into Montana may not be meeting the interim criteria, the Companies would have to discontinue discharging the produced water that is the source of the problems. The thresholds or criteria identified in the agreement are well below those that would result in interference with the existing uses of water. Therefore, the discharging of produced water would be discontinued before the produced water would interfere with any downstream uses of the water.

Impact and Mitigation Monitoring and Reporting

Appendix D of this EIS contains a framework for a Mitigation Monitoring and Reporting Plan (MMRP) that would be adopted for this project. This framework was developed to:

- Verify implementation of mitigation measures adopted in the ROD;
- Measure the success rate of those mitigation measures:
- Make appropriate modifications to mitigation based on actual performance;
- Allow for peer review of mitigation and monitoring results; and
- Provide feedback to the interested public.

Summary of Alternatives and Environmental Consequences

The following tables summarize the alternatives considered in detail and the likely environmental consequences of each alternative. Table 2–41 contains the summary of alternatives. This table contrasts the four alternatives in terms of their physical characteristics. The matrix presented in Table 2–42 provides a comparison summary of the effects to the various environmental resources that would be realized by implementing each of the four alternatives for the Powder River Basin Oil and Gas Project.

Agency-Preferred Alternative

The BLM's preferred alternative is Alternative 1 — Proposed Action. This alternative provides for the best balance of effects to costs and development of the CBM. Most of the federal minerals in the Project Area have already been leased. The pattern of federal and non-federal mineral ownership coupled with the BLM's responsibilities under 43 CFR 3162.2 to prevent drainage of federal oil and gas preclude the BLM from choosing Alternative 3 as the preferred alternative.

Alternatives 2A and 2B offer some advantages over Alternative 1; however, the advantages are insufficient to justify the additional costs and disturbance. Both alternatives 2A and 2B would increase short- and long-term disturbance over Alternative 1 by at least 10 percent. However, as documented in the analysis they would not substantially decrease effects to air quality, visibility, and water quality — the primary issues for which the alternatives were developed. The amount of CBM water produced by alternatives 1, 2A, and 2B would be the same. The costs of implementing the water handling procedures of alternatives 2A and 2B would be substantially higher than those associated with Alternative 1, but the difference between the effects of these two alternatives and Alternative 1 does not reflect or justify these additional costs. The analysis documents that the benefits to air quality and visibility from electrifying half or all of the booster compressors would be insufficient to justify the additional costs of requiring the Companies to use electric booster compressors. It is estimated that few booster compressors would be built on surface that is federally owned and BLM does not have the ability to require electrification of compressors constructed off of federal surface. The permitting of the compressors is the responsibility of the State of Wyoming.

Table 2–41 Summary Comparison of Alternatives Considered in Detail

Parameter	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3
New CBM Facilities				
Number of Wells				
Federal ownership	23,909	23,909	23,909	0
Non-federal ownership	15,458	15,458	15,458	15,458
Total	39,367	39,367	39,367	15,458
Number of Well Pads				
Federal ownership	15,455	15,455	15,455	0
Non-federal ownership	10,542	10,542	10,542	10,542
Total	25,997	25,997	25,997	10,542
Roads (miles)				
Improved	6,657	6,657	6,657	2,170
Two-track	10,619	10,619	10,619	4,337
Pipeline (miles)				
2–3-inch poly	14,127	14,127	14,127	5,769
12-inch poly	5,311	5,311	5,311	2,170
12-inch steel	1,036	1,036	1,036	396
Overhead Electric Line (miles)	5,311	5,311	5,311	3,170
Compressors				
Number of booster units	1,060	1,060	1,060	350
Number of booster stations	186	186	186	175
Total horsepower of booster units	371,000	371,000	371,000	122,500
Number of reciprocating units	298	298	298	97
Number of reciprocating stations	63	63	63	19
Total horsepower of reciprocating units	491,700	491,700	491,700	160,050
Water Handling Facilities				
Analyzed number of surface discharge facilities	1,216	498	795	419
Analyzed number of infiltration facilities	1,821	4,032	2,931	893
Analyzed number of containment impoundments	37	43	36	16
Analyzed number of injection wells	285	342	342	147
Projected Short-term Disturbance (acres)	211,992	230,886	222,860	90,807
Projected Long-term Disturbance (acres)	108,799	127,693	119,667	45,057
Workforce Requirements				
Construction and installation (number of workdays)	2,403,944	2,805,164	2,594,436	803,769
Operation and maintenance (number of workdays)	1,814,275	1,815,831	1,815,020	704,814
Reclamation and abandonment (number of workdays)	1,427,421	1,713,259	1,568,892	405,719
New non-CBM Facilities				
Number of new wells				
Federal ownership	1,791	1,791	1,791	0
Non-federal ownership	1,409	1,409	1,409	1,409
Total	3,200	3,200	3,200	1,409
Projected short-term disturbance (acres)	17,599	17,599	17,599	7,751
Projected long-term disturbance (acres)	14,402	14,402	14,402	6,339
Workforce Requirements				
Construction and installation (number of workdays)	96,800	96,800	96,800	43,712
Operation and maintenance (number of workdays)	73,600	73,600	73,600	29,275
Reclamation and abandonment (number of workdays)	19,200	19,200	19,200	8,070

Table 2–42 Summary of Effects, by Alternative

Potential Effect	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3
Groundwater				
Maximum Drawdown				
Fort Union Formation	300–1,200 feet	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Deep Wasatch Sands	10–250 feet	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Shallow Wasatch Sands	1–50 feet (in areas of thin Wasatch cover)	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
	-1 to –50 feet (below impoundments and creeks receiving CBM discharge)	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Period of Maximum Drawdown				
Fort Union Formation	2006–2009	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Deep Wasatch Sands	2009–2018	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Shallow Wasatch Sands	2006–2012 (drawdown areas) 2006–2009 (buildup areas)	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Recharge	Recharge of shallow Wasatch increased during CBM development due to infiltration below creeks and impoundments receiving CBM discharge water.	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Quality	Groundwater quality within the regional aquifer systems and alluvial aquifers would not be noticeably affected.	Same as Alternative 1	Same as Alternative 1.	Same as Alternative 1
Recovery	Rapid initial recovery of water levels in developed coals following cessation of CBM pumping. Typically >80% recovery within first 10 years. Recovery to within 20 to 50 feet of pre-development water levels occurs over 50 to 100 years. Similar pattern for deep Wasatch Sands but lagged by about 10 years.	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1

Table 2–42 Summary of Effects, by Alternative

Potential Effect	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3
Springs/Wells	Wells completed in developed coals within 10 miles of CBM development are likely to experience water level drops and possibly methane occurance. Flowing artesian wells and springs that are sourced within coals in this area are likely to experience decrease in flow rate. Wells and springs in Wasatch are not expected to be substantially affected unless they are within 100 feet (vertically) of developed coal.	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Surface Water				
Quantity	Perennial flows likely to develop in formerly ephemeral channels	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
	High seasonal flows expected to rise	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
CBM Produced Water discharged to surface	476,216 acre-feet	179,171 acre-feet	270,781 acre-feet	181,807 acre-feet
Quality	Negligible changes in water quality of main stems.	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
	Concentrations of suspended sediment in surface waters likely to rise above present levels due to runoff from disturbed areas.	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
	SAR values and sodium concentrations may inhibit the use of irrigation on some tributaries.	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
	Evaporation may cause concentrations of salts and other metals in impoundments and surface drainages.	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Surface Drainages	Erosion of surface drainages would occur due to increased flows.	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
	Channels are more likely to overbank during snowmelt due to increased flows from CBM discharges	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Surface Waterbodies	Reservoirs downstream likely would receive more water and could receive more sediment.	Numerous impoundments would serve as flood control structures during high seasonal flows.	Same as Alternative 1	Same as Alternative 1
	Springs may develop in drainages where infiltration is enhanced.	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1

Table 2–42 Summary of Effects, by Alternative

Potential Effect	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3
Surface Water Use	Increased availability of surface water for irrigation and other downstream beneficial uses.	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
	Potential reduction of flows by impoundments may diminish water availability to permitted water right holders downstream	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Physiography, Geology, Paleontology, and Minerals				
Paleontology	If Class 3, 4, or 5 formations are present in areas of disturbance, ground-disturbing activities could damage or destroy surface and sub-surface fossils.	Similar to Alternative 1, but with a higher potential due to a larger amount of disturbance.	Similar to Alternative 1, but with a higher potential due to a larger amount of disturbance.	Similar to Alternative 1, but with a reduced potential due to a smaller amount of disturbance.
Minerals	Would produce about 16 trillion cubic feet of CBM.	Same as Alternative 1	Same as Alternative 1	Would produce about 8 trillion cubic feet of CBM.
	Would produce about 220 million barrels of oil equivalent from the non-CBM wells.			Would produce about 100 million barrels of oil equivalent from the non-CBM wells.
Geological Hazards	Implementation is unlikely to cause noticeable ground subsidence or increase the potential for underground coal fires. Migration of some CBM could occur within the PRB as development of CMB occurs.	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1. but to a smaller extent due to the smaller number of wells.
Soils				
Erosional effects from facilities located on soils with high wind erosion potential	Increased wind erosion due to removal of vegetation, excavation, and stockpiling of soil, especially in sandy soils. Approximately 25,474 acres in the short term and 13,403 acres in the long term would be disturbed on soils with a high wind erosion potential.	Nearly the same as Alternative 1, with a very minor increase in disturbed area because of the change in water handling options. Due to the decrease in Surface Discharge and the increase in impoundments, the potential for wind erosion would increase slightly.	Nearly the same as Alternative 1, with a very minor increase in disturbed area because of the change in water handling options. Due to the decrease in Surface Discharge and the increase impoundments, the potential for wind erosion would increase slightly, but increase would be less than in Alternative 2A.	All disturbance would be roughly cut in half. As Alternative 3 would employ the same water handling options as Alternative 1, effects would be similar but on a smaller scale.

Table 2–42 Summary of Effects, by Alternative

	Alternative			
Potential Effect	1	2A	2B	3
Erosional effects from facilities located on soils with high water erosion potential	Increased water erosion and sedimentation due to removal of vegetation, excavation, slope steepening and compaction, especially in clayey soils. Approximately 76,691 acres in the short term and 38,452 acres in the long term would be disturbed on soils with high water erosion potential. Soil loss estimates on these soils range from 3.4 to 18.7 tons/acre/year on bare soil and 0.5 to 2.6 tons/acre/year one year after reclamation.	Nearly the same as Alternative 1, with a very minor increase in disturbed area because of the change in water handling options. Due to the decrease in Surface Discharge and the increase in impoundments, the potential for water erosion would increase slightly.	Nearly the same as Alternative 1, with a very minor increase in disturbed area because of the change in water handling options. Due to the decrease in Surface Discharge and the increase in impoundments, the potential for water erosion would increase slightly, but increase would be less than in Alternative 2A.	All disturbance would be roughly cut in half. As Alternative 3 would employ the same water handling options as Alternative 1, effects would be similar but on a smaller scale.
Facility location on slopes greater than 25 percent	No facilities would be located on sloped greater then 25 percent Roads would be located to avoid steep slopes	No facilities would be located on sloped greater then 25 percent Roads would be located to avoid steep slopes	No facilities would be located on sloped greater then 25 percent Roads would be located to avoid steep slopes	No facilities would be located on sloped greater then 25 percent Roads would be located to avoid steep slopes
Effects on soil productivity	Reduction in soil productivity due to removal of vegetation, compaction, changes in salinity, excavation and stockpiling of soil. Approximately 206,777 acres in the short term and 103,800 acres in the long term would be disturbed on soils with high compaction potential, low revegetation potential, high salinity, or on Prime Agricultural soils.	Nearly the same as Alternative 1, with a very minor increase in disturbed area because of the change in water handling options. Due to the decrease in Surface Discharge and the increase in impoundments, the potential for infiltration would be reduced but soil mixing and compaction would increase slightly.	Nearly the same as Alternative 1, with a very minor increase in disturbed area because of the change in water handling options. Due to the decrease in Surface Discharge and the increase in impoundments, the potential for infiltration would be reduced but soil mixing and compaction would increase slightly. These changes in effects from Alternative 1 would be less than those experienced under Alternative 2A.	All disturbance would be roughly cut in half. As Alternative 3 would employ the same water handling options as Alternative 1, effects would be similar but on a much smaller scale.
Air Quality				
Compliance with Wyoming and federal ambient air quality standards	Yes	Yes	Yes	Yes

Table 2–42 Summary of Effects, by Alternative

Potential Effect	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3
Within range of States' hazardous air pollutant thresholds for maximum 8-hour concentrations	Yes	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
N-Hexane	Yes			
Benzene	Yes			
Toluene	Yes			
Ethylbenzene	Yes			
Xylene	Yes			
Formaldehyde	Above strictest threshold, but well within range			
Compliance with cancer risk threshold:		Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Benzene	Yes			
Formaldehyde	Yes			
Compliance with visibility thresholds in sensitive Class I and Class II areas:				
ΔdV > 1.0 dV	Up to 11.5 days	Up to 10.3 days	Up to 9.5 days	Up to 6.6 days
ΔdV > 0.5 dV	Up to 43.7 days	Up to 41.1 days	Up to 37.9 days	Up to 28.7 days
Vegetation				
Overall long-term vegetation displacement	128, 069 acres	146,963 acres	138,937 acres	52,231 acres
Sagebrush shrublands	40,007 acres	45,943 acres	43,517 acres	15,311 acres
Riparian, wetlands	3,327 acres	7,266 acres	3,402 acres	2,999 acres
Wildlife				
Big Game Species' Important Habitats				
Pronghorn Winter-yearlong range	Approx. 2 percent of this range would be disturbed in the Project Area over the long-term.	Same as Alternative 1	Same as Alternative 1	Approx. 1 percent of this range would be disturbed in the Project Area over the long-term.
White-tailed Deer Winter-yearlong and Yearlong Ranges	Less than 1 percent of both ranges would be disturbed in the Project Area over the long term. 100 percent of the winter-yearlong disturbance would occur in the Middle Powder River sub-watershed.	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Mule deer winter-yearlong range	Approximately 1 percent of winter-yearlong range would be disturbed in the Project Area over the long-term — about 50 percent of which would occur in the Upper Powder River sub-watershed.	Less than 1 percent of winter-yearlong range would be disturbed in the Project Area over the long-term — about 50 percent of which would occur in the Upper Powder River sub-watershed.	Approximately 1 percent of winter-yearlong range would be disturbed in the Project Area over the long-term — approximately 58 percent of which would occur in the Upper Powder River sub-watershed.	Less than 1 percent of winter-yearlong range would be disturbed in the Project Area over the long-term 100 percent of which would occur in the Upper Powder River sub-watershed.

Table 2–42 Summary of Effects, by Alternative

Potential Effect	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3
Elk crucial winter range (Fortification Creek)	Approximately 3 percent of crucial winter range would be disturbed in Fortification Creek Management Area.	Approximately 4 percent of crucial winter range would be disturbed in Fortification Creek Management Area.	Same as Alternative 1	Same as Alternative 1
Big Game	Habitat fragmentation may alter big game use of habitats. Human disturbance may deter big game from otherwise suitable habitats to potentially lower quality habitats. Increased human activities may result in increased vehicle collisions, poaching and legal hunting success.	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Raptors	Disturbance of ground nesting and prey habitats would occur. Increased human presence may alter raptor activity patterns. New utility poles may provide new perch sites for raptors. New aboveground lines and the potential for increased vehicle/wildlife collisions may increase mortality of local raptors. Habitat disturbance may alter local prey availability.	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Sage and Plains Sharp-tailed Grouse	Habitat disturbance may occur in suitable nesting, feeding and brood rearing habitats; increased human activity may affect nesting, breeding, and brood rearing; Increased number of aboveground utility lines may result in increased number of grouse collisions if appropriate mitigation efforts are not implemented.	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Waterfowl	Habitat disturbance may be local beneficial or detrimental depending on local hydrological conditions. Benefits may include creation of new habitats and/or improvements of existing habitats. Production waters may also result in the elimination oar degradation of existing habitats. Indirect effects to aquatic plants and invertebrates may occur from exposure to elevated levels of salts and metals in production waters.	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1

Table 2–42 Summary of Effects, by Alternative

	Alternative			
Potential Effect	1	2A	2B	3
Aquatic Life	Surface discharge of produced CBM water in 10 sub-watersheds would potentially increase stream flows, increases in sedimentation, increases of salt concentrations in streams and ponds, and increases of heavy metal concentrations in streams and ponds. The largest amount of surface discharge (62% of 39,367 wells) is proposed under this alternative and would result in the most potential effects to aquatic species.	Surface discharge of produced CBM water in 10 sub-watersheds would potentially increase stream flows, increases in sedimentation, increases of salt concentrations in streams and ponds, and increases of heavy metal concentrations in streams and ponds. 25% of 39,367 wells are proposed to surface discharge under this alternative and would result in less potential effects to aquatic species than Alt. 1 and Alt. 2B.	Surface discharge of produced CBM water in 10 sub-watersheds would potentially increase stream flows, increases in sedimentation, increases of salt concentrations in streams and ponds, and increases of heavy metal concentrations in streams and ponds. 40% of 39,367 wells are proposed to surface dishcarge under this alternative and would result in more potential effects to aquatic species than Alt. 2A and less than Alt. 1.	Surface discharge of produced CBM water in 10 sub-watersheds would potentially increase stream flows, increases in sedimentation, increases of salt concentrations in streams and ponds, and increases of heavy metal concentrations in streams and ponds. The least amount of surface discharge (54% of 15,458 wells) is proposed under this alternative and would result in the smallest amount of potential effects to aquatic species of all Alternatives.
Threatened, Endangered, or Sensitive Species				
Black-tailed prairie dog	Project activities would directly affect individuals and suitable habitats, if appropriate mitigation measures are not implemented.	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Preble's meadow jumping mouse	No affects to this species due to assumed lack of occurrence within the Project Area.	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Black-footed ferret	No affects to this species due to assumed lack of occurrence within the Project Area.	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Bald eagle	Nesting and winter roosting may be affected by increased human activities and local habitat disturbance; and elevated traffic levels in the Project Area may increase eagle/vehicle collisions if mitigation measures are not implemented.	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Mountain plover	Human disturbance to suitable nesting and brood rearing habitats may affect this species.	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1
Western boreal toad	No affects to this species due to assumed lack of occurrence within the Project Area.	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1

Table 2–42 Summary of Effects, by Alternative

	Alternative			
Potential Effect	1	2A	2B	3
Cultural Resources				
Total number of cultural resource sites that may be affected (based on known site densities):	3,288	3,604	3,435	1,696
General Distribution of Effects	The greatest anticipated effects would be in the Clear Creek, Upper Powder River, Crazy Woman Creek and Antelope Creek sub-watersheds. It is expected that 430 sites may be historic properties requiring some form of protection or mitigation.	The greatest anticipated effects would be in the Clear Creek, Upper Powder River, Crazy Woman Creek and Antelope Creek sub watersheds. It is expected that 470 sites may be historic properties requiring some form of protection or mitigation. Because of additional water handling facilities along the drainages, this alternative is likely to require more protective or mitigative measures than the other alternatives.	The greatest anticipated effects would be in the Clear Creek, Upper Powder River, Crazy Woman Creek and Antelope Creek sub watersheds. It is expected that 445 sites may be historic properties requiring some form of protection or mitigation.	The greatest anticipated effects would be in the Clear Creek, Upper Powder River, Crazy Woman Creek and Antelope Creek sub watersheds. It is expected that 220 sites may be historic properties requiring some form of protection or mitigation. Some infrastructure or support facilities may occur on federal surface for private development, but federal control over the identification and protection of historic properties would be minimal.
Land Use and Transportation				
Displacement of Rangeland Resources				
Short-term (acres)	229,591	248,485	240,459	108,406
Long-term (acres)	123,201	142,095	134,069	51,396
Additional Vehicle Trips				
Construction and Installation	3,129	3,630	3,366	1,059
Operation and Maintenance	790	790	790	506
Decommissioning & Reclamation	1,206	1,444	1,324	230
Change in average daily traffic relative to Existing Conditions	Over the entire Project Area, the average daily traffic is expected to increase more than 25 percent. The amount of increase on specific roads would vary greatly.	Same as Alternative 1	Same as Alternative 1	Same as Alternative 1

Table 2–42 Summary of Effects, by Alternative

	Alternative			
Potential Effect	1	2A	2B	3
Visual Resources	317 wells, associated roads, and water handling facilities would be constructed on VRM Class II areas. Class II management objectives would be met if mitigation were successfully implemented. Management objectives for 3,939 wells and associated facilities for Class III areas and 4,530 wells and associated facilities for Class IV areas would be met. 437 wells and associated facilities would be constructed on TBNG areas managed with (Scenic Integrity Objectives (SIO) of Low. Desired conditions for SIO would be met, in that facilities can be visible if they are reasonably mitigated to blend and harmonize with natural features.	Wells and roads are same as Alternative 1. Water handling methods would disturb 6,682 additional acres. Class II management objectives would be met if mitigation were successfully implemented.	Wells and roads are same as Alternative 1. Water handling methods would disturb 6,682 additional acres as in Alternative 2A. However, a smaller number of acres would be disturbed by impoundments than Alternative 2A, with a proportionately smaller visual impact. Class II management objectives would be met if mitigation were successfully implemented.	No wells and associated facilities would be constructed on federal leases. Visual impacts from construction and operation would occur on State and private lands.
Recreational Resources	Construction activities would alter the recreational experience through a loss of solitude and the natural setting. After construction, the loss of solitude would be less because of greatly reduced traffic. Installation and operation of facilities would still affect the natural setting of the Project Area for the life of the project. Recreation in special management areas would not be affected. BLM and FS objectives for recreation would be met.	The effect on recreational opportunities from the construction of wells and associated facilities are same as Alternative 1. Water handling methods would disturb an additional 6,682 acres, resulting in a greater loss of solitude and the natural setting.	The effect on recreational opportunities from the construction of wells and associated facilities are same as Alternative 1. Water handling methods would disturb 6,682 additional acres as in Alternative 2A. However, a smaller number of acres would be disturbed by impoundments than Alternative 2A, with a proportionately smaller loss of solitude and the natural setting.	No wells and associated facilities would be constructed on federal leases. No impacts to recreation would occur on BLM lands or the TBNG. Loss of solitude and natural setting could occur on State and private lands.
Socioeconomics				
Effects to Employment	➢ 1,974 CBM workers and 67 non-CBM workers would be required. ➢ Employment would be greatest in first 10 years. ➢ Workers already exist in the community. ➢ Secondary employment would be sustained for a longer period than previously anticipated.	➢ 2,260 CBM workers and 67 non-CBM workers would be required. ➢ Employment would be greatest in first 10 years. ➢ Workers already exist in the community.	➢ 2,112 CBM workers and 67 non-CBM workers are required. ➢ Employment would be greatest in first 10 years. ➢ Workers already exist in the community.	➢ 607 new CBM and 30 non-CBM workers would be required. ➢ Employment would be greatest in first 10 years. ➢ Workers already exist in the community.

Table 2–42 Summary of Effects, by Alternative

Potential Effect	Alternative 1	Alternative 2A	Alternative 2B	Alternative 3
Effects to Wages	➢ Combined annual payroll of the Companies would average an estimated $81.6 million. ➢ Over a 20 period $1.6 billion in personal income would be generated. ➢ Once the project is completed, a reduction in total annual income in the four counties would decline.	➢ Combined annual payroll of the Companies would average an estimated $93 million.	➢ Combined annual payroll of the Companies would average an estimated $87.1 million.	➢ Combined annual payroll of the Companies would average an estimated $25.5 million.
Effects on housing and community infrastructure	➢ Minor employment/population changes are anticipated because most employees are expected to be hired locally. ➢ Rental vacancy rates for 2000 were .2% lower than the average for Wyoming. Additional rental units may be constructed if existing supply of vacant rental units become exhausted. ➢ Due to the minor population influx, there would be minimal impact to water supply, wastewater systems, solid waste disposal, schools, fire protection, and medical facilities. ➢ The Proposed Action would result in increased traffic on roads and therefore road maintenance demands (see transportation).	➢ No change from proposed action ➢ Increase road maintenance due to construction and maintenance of water handling facilities.	Same as Alternative 2A	➢ Population change would not occur and there would be no negative housing or infrastructure effects.

Table 2–42 Summary of Effects, by Alternative

	Alternative			
Potential Effect	1	2A	2B	3
Royalties and taxes generated	➢ Federal Royalties = $3.1 billion ➢ State Royalties = $462 million ➢ Sales tax (4%paid to State, 1% paid to counties) = $76.6 million ➢ Severance (paid to State) = $2.4 billion ➢ Ad Valorem (paid to four counties) ➢ Campbell Co.= $1.5 billion ➢ Converse Co.= $32 million ➢ Johnson Co.= $690 million ➢ Sheridan Co.= $443 million	➢ Same royalties as Proposed Action ➢ More taxes would be generated due to the number and cost of water handling facilities.	Same as Alternative 2A	➢ $3.1 billon less in Federal Royalties ➢ $835 million less in Severance Tax ➢ $1.06 billion less in ad valorem tax ➢ Not drilling Federal wells may result in future negative production rates from Federal minerals, due to depletion from drilling on State and private lands.
Water handling cost to industry (all other development costs are constant among Alternatives 1, 2A, and 2B)	Surface Discharge = $954 million Infiltration = $1.05 billion Containment =$226 million LAD= $36 million Injection =$170 million TOTAL =$ 2.4 billion	Surface Discharge = $360 million Infiltration = $2.23 billion Containment = $263 million LAD = $115 million Injection = $184 million TOTAL = $3.1 billion	Surface Discharge = $1.2 billion Infiltration = $1.6 billion Containment = $239 million LAD= $115 million Injection = $184 million TOTAL = 3.3 billion	Surface Discharge = $363 million Infiltration = $478 million Containment = $98 million LAD = $16.7 million Injection = $73 million TOTAL = $1.03 billion
Non-water handling costs (Drilling, O & M, Reclamation)	$5.84 billion	$5.84 billion	$5.84 billion	$2.28 billion
Net Cost of Alternative	$8.28 billion	$8.96 billion	$9.17 billion	$3.31 billion